Astr. P 183 n

<36604396590016

<36604396590016

Bayer. Staatsbibliothek

The FIRST BOOK.

THE

DISCOVERY

OF A

NEW WORLD.

OR,

A Discourse tending to prove, *That* ('tis probable) *there may be another Habitable World in the Moon.*

With a Discourse concerning the Possibility of a Passage thither.

The Fifth Impression; Corrected and Enlarged.

Quid tibi inquis ista proderunt? Si nihil aliud, hoc certè, sciam omnia hìc angusta esse. Seneca Præf. ad 1. Lib. Nat. Quæst.

By the Right Reverend Father in God, *JOHN WILKINS*, late Lord Bishop of *CHESTER*.

LONDON:

Printed for *John Nicholson* at the *King's-Arms* in *Little Britain*; *Benj. Tooke* at the *Middle Temple* Gate in *Fleetstreet*; *And. Bell* at the *Cross Keys and Bible* in *Cornhill*; and *Ralph Smith* under the *Piazza* of the *Royal-Exchange*. MDCCVII.

Ask. P. 183 m

RAVENSDALE
LIBRARY

THE

Mathematical and *Philosophical*

WORKS

Of the Right Reverend

JOHN WILKINS,

Late Lord Bishop of *CHESTER.*

CONTAINING,

I. The Discovery of a New World: Or, a Discourse tending to prove, that 'tis probable there may be another Habitable World in the Moon. With a Discourse of the Possibility of a Passage thither.

II. That 'tis probable our Earth is One of the Planets.

III. *Mercury*: Or, *The Secret and Swift Messenger.* Shewing how a Man may with Privacy and Speed communicate his Thoughts to a Friend at any Distance.

IV. *Mathematical Magick*: Or the Wonders that may be perform'd by *Mechanical Geometry*.

V. An Abstract of his Essay towards a *Real Character*, and a *Philosophical Language.*

To which is prefix'd the AUTHOR's LIFE, and an Account of his Works.

Wilkins's Works

LONDON:

Printed for *J. Nicholson*, at the *King's-Arms* in *Little Britain*; *A. Bell*, at the *Cross-Keys* in *Cornhill*; *B. Tooke*, at the *Middle-Temple-Gate* in *Fleetstreet*; and *R Smith* under the *Piazza's* of the *Royal-Exchange.* M DCC VIII.

1496

BIBLIOTHECA
REGLA
MONACENSIS.

THE LIFE of the AUTHOR: AND AN Account of his WRITINGS.

HE *was Son to* Walter Wilkins, *Citizen and Goldſmith of* Oxford; *was born at* Fawlſly, *near* Daventry, *in* Northamptonſhire, *in the Houſe of the Reverend and well known Mr.* John Dod, *who wrote upon the Commandments, he being his Grandfather by the Mother's ſide. He was taught his* Latin *and* Greek *by* Edward Sylveſter, *a noted* Grecian, *who kept a Private School in the Pariſh of* All Saints *in* Oxford: *His Proficiency was ſuch, that at Thirteen Years of Age he entred a Student in* New-Inn, *in* Eaſter-Term, 1627. *He made no long ſtay there, but was remov'd to* Magdalen-Hall, *under the Tuition of Mr.* John Tombes, *and there he took his Degrees in Arts. He afterwards entred into Orders, and was firſt Chaplain to* William *Lord* Say, *and then to* Charles *Count Palatine of the* Rhine, *and Prince Elector of the Empire, with whom he continued for ſome time.*

Upon the breaking out of the Civil War, he join'd with the Parliament, and took the Solemn League and Covenant. *He was afterwards made Warden of* Wadham *College by the Committee of Parliament appointed for Reforming the Univerſity; and being created Batchelor of Divinity,* April 12. 1648. *was the Day following put in poſſeſſion of his Wardenſhip. Next Year he was created Doctor of Divinity, and about that time took the* Engagement *then en-join'd by the Powers in being.*

In 1656. *he married* Robina, *the Widow of* Peter French, *formerly Canon of* Chriſt-Church, *Siſter to* Oliver, *then Lord Protector. In* 1659. *he was by* Richard *the Protector made Head of* Trinity *College in* Cambridge, *the beſt Preferment in that Univerſity.*

After King Charles *the* IId's *Restoration, he was ejected from thence, and became Preacher to the Honourable Society of* Grays-Inn, *and Minister of St.* Lawrence Jury, London, *in the room of Dr.* Ward. *About this Time he became a Member of the* Royal Society, *was chosen one of their Council, and prov'd one of their most Eminent Members, and Chief Benefactors. Soon after this he was made Dean of* Rippon, *and by the Interest of the late Duke of* Buckingham, *he was created Bishop of* Chester, *and consecrated in the Chappel of* Ely-*House in* Holbourn, *the* 15*th of* November, 1668. *by Dr.* Cosin, *Bishop of* Durham; *Dr.* Laney, *Bishop of* Ely; *and Dr.* Ward, *Bishop of* Salisbury; *on which Occasion Dr.* Tillotson, *afterwards Archbishop of* Canterbury, *preach'd an Excellent Sermon.*

He was a Person of great Natural Endowments, and by his Indefatigable Study attain'd to an Universal Insight into all, or at least most Parts of Useful Learning. He was a great Mathematician, and very much advanc'd the Study of Astronomy, *both while he was Warden of* Wadham *College in* Oxford, *and at* London, *when he was a Member of the* Royal Society. *He was as well seen in Mechanicks and Experimental Philosophy as any Man in his Time, and was a great Promoter of them. In Divinity, which was his main Business, he excelled, and was a very Able Critick; his Talent of Preaching was admirable, and more suited to profit than to please his Hearers; he affected an Apt and Plain Way of Speech, and expres's'd his Conceptions in a Natural Style. In his Writings he was Judicious and Plain, and valued not Circumstances so much as the Substance. This appear'd evident in whatever Subject he undertook, which he always made easier for those that came after him.*

He treated sometimes on Matters that did not properly belong to his Profession; but always with a Design to make Men wiser and better; which was his chief End in promoting Universal Knowledge, and one of the main Reasons for his entring into the Royal Society. *His Virtues and Graces were very uncommon; at least as to that Degree of*

them

them to which he attain'd: His Prudence was very remarkable, and ſeldom fail'd him; but he was ſo Openhearted and Sincere himſelf, that he was ready (except he knew ſome Cauſe to the contrary) to think other Men to be ſo too; by which he was ſometimes impos'd on.

His Greatneſs of Mind was evident to all that knew any thing of him, nor was the Depth of his Judgment leſs diſcernible. He never was eager in Purſuit of Dignities; but was advanc'd to them by his Merit. He contemn'd Riches as much as others admir'd them; and ſpent his Eccleſiaſtical Revenues in the Service of the Church from which he receiv'd them; and being ſecur'd againſt Want, he would often ſay, That he would be no Richer: *And his Conduct made it evident that he was as good as his word.*

He was a Stranger to Revenge, and yet not unſenſible of Perſonal Injuries, eſpecially ſuch as reflected on his Good Name, if they proceeded from ſuch as had a good Reputation of their own. The Reproaches of others he deſpis'd; but frequently wiſh'd he had been better underſtood by the former: He bore it, however, patiently, as his Misfortune; never requited them with the like meaſure; but always mention'd them with Reſpect, and laid hold on all Opportunities to oblige and do them good.

His Converſation was profitable and pleaſant; and his Diſcourſe was commonly of uſeful Things; without occaſioning Trouble or Wearineſs in thoſe that converſed with him. He cultivated that moſt neceſſary (but too much neglected) Part of Friendſhip, To give ſeaſonable Reproof, and wholſome Advice, upon Occaſion. This he did with a great deal of Freedom; but with ſo much Calmneſs and Prudence, that it ſeldom gave Offence.

He was particularly careful of the Reputation of his Friends; and would ſuffer no Blot to lye upon the Good Name or Memory of any of them, if he could help it.

His Enemies, who were Strangers to Moderation themſelves, made that Virtue in which he excell'd, the chief Subject of their Reproaches, as if he had been a Perſon of

unſteddy

unſteddy Principles, and not fixed in Matters of Religion; this drew ſevere Cenſures upon him from Archbiſhop Sheldon, *Biſhop* Fell, *and Archbiſhop* Dolben, *&c. without conſidering that he could not but have a great deal of Charity for Diſſenters, by reaſon of his Education under Mr.* John Dod *hss Grandfather, a truly Pious and Learned Man; who diſſented in many Things from the* Church of England *long before the Separation which afterwards follow'd upon Archbiſhop* Laud's *Severities and new Impoſitions.*

And as his ſaid Grandfather never approv'd of the Extremities on the other Side, but continu'd Loyal to the laſt, and adviſ'd others to continue in their Allegiance; in like manner Doctor Wilkins, *(tho' he had Clearneſs when the Government was diſſolv'd, to ſubmit to the Powers then in Being, by which he procur'd an Intereſt and a Share in the Government of both Univerſities;) was always a Friend to thoſe who were Loyal, and continu'd well affected to the Church of* England, *and protected ſeveral of 'em by the Intereſt he had in the then Government.*

After the Reſtoration he conform'd himſelf to the Church of England, *and ſtood up for her Government and Liturgy; but diſlik'd Vehemence in little and unneceſſary Things, and freely cenſur'd it as Fanataciſm on both ſides.*

Having thus conform'd to the Church *himſelf, he was very willing to bring over others: In which he was not without Succeſs, eſpecially in his own Dioceſe; where the Extremes on both Sides were as remarkable, as in moſt Parts of the Nation. Being a Perſon of Extenſive Charity himſelf, he was for an Indulgence and a Comprehenſion, in order to have brought our Diviſions in Matters of Religion to a Concluſion; which drew upon him the Hatred and Obloquy of thoſe who were for contrary Meaſures.*

His indefatigable Pains in Study brought the Stone upon him; which prov'd incurable. He had for many days a Proſpect of Death; which he view'd in its Approaches, and gradual Advances upon him: And a few days before his Diſſolution, he frequently ſaid, That he found a Sentence

tence of Death within himself. But in the height of his Pain and Apprehensions of Death, he shewed no Dismay or Surprize, nor was ever heard to utter a Word unbecoming a Wise Man, or a true Christian. And thus he concluded his Days with Constancy of Mind, Contempt of the World, and chearful Hopes of a Blessed Eternity, through Faith in our Lord Jesus Christ. He died in the House of his Friend Dr. Tillotson, *in* Chancery-lane *in* London, *on the* 19*th of* November, 1672. *and was buried on the* 12*th of* December *following, under the* North *Wall of the Chancel of the Church of St.* Lawrence Jewry, *where he had formerly been Minister. His Funeral Sermon was preach'd by Dr.* William Lloyd, *then Dean of* Bangor, *(now Lord Bishop of* Worcester*) at the* Guild-hall-Chappel *in* London; *by which, those who are Curious may be satisfy'd, that every Part of the Character here given him, may be justify'd to Advantage.*

As a further Proof of it, and particularly of his unwearied Endeavours to promote Universal Knowledge, 'tis proper to subjoin a Catalogue of his Works.

1. *The first was entitled,* The Discovery of a New World; or, A Discourse tending to prove, That ('tis probable) there may be another Habitable World in the Moon. *Printed at* London *in* 4to. 1638. *and had Four Editions, the last in* 1684.

2. Discourse concerning the Possibility of a Passage to the World in the Moon. *Printed with the* Discovery.

3. Discourse concerning a New Planet; tending to prove, That ('tis probable) our Earth is one of the Planets. *London,* 1640, *in* 8vo.

The Author's Name is put to none of the Three; but they were so well known to be his, that Langrenus, *in his Map of the Moon, (Dedicated to the King of* Spain*) calls one of the Spots of his Selenographick Map after his Name.*

4. *Mercury*; or, The Secret Messenger: Shewing how a Man may with Privacy and Speed communicate

cate his Thoughts to his Friend at any Distance. *London*, 1641. *The Publication of this was occasion'd by the writing of a little thing, call'd* Nuncius Inanimatus, *by* Francis Goodwin.

5. Mathematical Magick; or, The Wonders that may be perform'd by Mechanical Geometry. In Two Books. *Printed at* London, *in* 1648. *and* 1680. *in* 8vo.

All these Five are entire in this Volume; Printed from the best Editions Corrected by the Author's own Hand.

6. *Ecclesiastes*; or, A Discourse of the Gift of Preaching, as it falls under the Rules of Art. *London*, 1646, 47, 51, 53, *and* 75. 8vo.

7. Discourse concerning the Beauty of Providence, in all the rugged Passages of it. *London*, 49. in 12o; *and in* 77. *the Fifth Edition, in* 8vo.

8. Discourse concerning the Gift of Prayer; shewing what it is; wherein it consists; and how far it is attainable by Industry, *&c.* *London*, 1653, *and* 1674. 8vo.

9. Of the Principles and Duties of Natural Religion. Two Books. *London*, 1675. 8vo. *Published by* John Tillotson, *D. D.*

10. Sermons preach'd upon several Occasions. *London*, 1682. 8vo. *They are in number Fifteen, published by Dr.* Tillotson.

11. Essay towards a Real Character, and a Philosophical Language. *London*, 1668. *Fol.*

An Alphabetical Dictionary: Wherein all *English* Words, according to their various Significations, are either referred to their Places in the Philosophical Tables, or explain'd by such Words as are in those Tables. *This is printed with the* Essay.

This Book is mentioned in the last place, tho' it be not the last in Order of Time; because the Design being extraordinary and very curious, and printed by Order of the Royal Society, *'twas thought proper to give an Abstract of it at the End of this Volume.*

THE

Saturnus
Jupiter
Mars
Proserpina
Ceres et
Venus
Mercurius
lucem
Omnibus do calorem
motum
Suo Jovent
Mutuo se illuminant
Universu ornant
Quid si sic?
Utinam et alæ
Hic ejus oculi
A Discourse
concerning
A NEW
World
&
Another Planet
In 2 Books
London
Printed in y year
of our Lord 1708
The 5 Edition
N. Copernicus
Galilæus
Keplar

UNIVERSITÄTS
BIBLIOTHEK
MÜNCHEN

To the Reader.

IF amongst thy Leisure Hours, thou canst spare any for the Perusal of this Discourse, and dost look to find somewhat in it which may serve for thy Information and Benefit; let me then advise thee to come unto it with an equal Mind, not swayed by Prejudice, but indifferently resolved to assent unto that Truth which upon deliberation shall seem most probable unto thy Reason; and then I doubt not, but either thou wilt agree with me in this Assertion, or at least not think it to be as far from Truth, as it is from common Opinion.

Two Cautions *there are, which I would willingly admonish thee of in the Beginning:*

1. *That thou shouldst not here look to find an exact accurate Treatise; since this Discourse was but the Fruit of some lighter Studies, and those too huddled up in a short time; being first thought of and finished in the space of some few Weeks; and therefore you cannot in reason expect that it should be so polish'd, as perhaps the Subject would require, or the Leisure of the Author might have done it.*

2. *To remember that I promise only probable Arguments for the Proof of this* Opinion; *and therefore you must not look that every Consequence should be of an undeniable Dependance; or that the Truth of each Argument should be measured by its Necessity. I grant, that some Astronomical Appearances may possibly be solved otherwise than here they are: But the thing I aim at is this; that probably they may so be solved, as I have here set them down. Which, if it be granted (as I think it must) then I doubt not, but the indifferent Reader will find some Satisfaction in the Main Thing that is to be proved.*

To the Reader.

Many ancient Philosophers of the better Note, have formerly defended this Assertion which I have here laid down; and it were to be wished, that some of us would more apply our Endeavours unto the Examination of these old Opinions; which, tho' they have for a long time lien neglected by others, yet in them may you find many Truths well worthy your Pains and Observation. 'Tis a false Conceit, for us to think that amongst the ancient Variety and Search of Opinions, the best hath still prevailed. Time (saith the Learned Verulam*) seems to be of the nature of a River or Stream; which carrieth down to us that which is light, or blown up, but sinketh that which is weighty and solid.*

It is my desire, that by the Occasion of this Discourse, I may raise up some more active Spirit to a Search after other hidden and unknown Truths: Since it must needs be a great Impediment unto the Growth of Sciences, for Men still so to plod on upon beaten Principles, as to be afraid of entertaining any thing that may seem to contradict them. An Unwillingness to take such things into Examination, is one of those Errors of Learning, in these Times observed by the Judicious Verulam. *Questionless there are many secret Truths which the Ancients have passed over, that are yet left to make some of our Age famous for their Discovery.*

If by this Occasion I may provoke any Reader to an Attempt of this Nature, I shall think my self happy, and this Work successful.

Farewell.

The

The Propositions that are proved in this Discourse.

Proposition I.

THat the Strangeness of this Opinion is no sufficient Reason why it should be rejected; because other certain Truths have been formerly esteemed ridiculous, and great Absurdities entertained by common Consent. By way of Preface.

Prop. II.

That a Plurality of Worlds does not contradict any Principle of Reason or Faith.

Prop. III.

That the Heavens do not consist of any such pure Matter which can privilege them from the like Change and Corruption, as these Inferior Bodies are liable unto.

Prop. IV.

That the Moon is a Solid, Compacted, Opacous Body.

Prop. V.

That the Moon hath not any Light of her own.

Prop. VI.

That there is a World in the Moon, hath been the direct Opinion of many ancient, with some modern Mathematicians; and may probably be deduced from the Tenents of others.

Prop.

Prop. VII.

That those Spots and brighter Parts, which by our Sight may be distinguished in the Moon, do shew the Difference betwixt the Sea and Land in that other World.

Prop. VIII.

That the Spots represent the Sea, and the brighter Parts the Land.

Prop. IX.

That there are High Mountains, Deep Vallies, and Spacious Plains in the Body of the Moon.

Prop. X.

That there is an Atmo-Sphæra, or an Orb of gross vaporous Air, immediately encompassing the Body of the Moon.

Prop. XI.

That as their World is our Moon, so our World is their Moon.

Prop. XII.

That 'tis probable there may be such Meteors belonging to that World in the Moon, as there are with us.

Prop. XIII.

That 'tis probable there may be Inhabitants in this other World; but of what kind they are, is uncertain.

Prop. XIV.

That 'tis possible for some of our Posterity to find out a Conveyance to this other World; and, if there be Inhabitants there, to have Commerce with them.

Bayerische
Staatsbibliothek
München

The First Book.

That the Moon may be a World.

The first Propoſition, by way of Preface.

That the Strangeneſs of this Opinion is no ſufficient Reaſon why it ſhould be rejected; becauſe other certain Truths have been formerly eſteem'd ridiculous, and great Abſurdities entertain'd by common Conſent.

THERE is an Earneſtneſs and Hungering after Novelty, which doth ſtill adhere unto all our Natures; and it is part of that Primitive Image, that wide Extent and infinite Capacity at firſt created in the Heart of Man. For this, ſince its Depravation in *Adam*, perceiving it ſelf altogether emptied of any good, doth now catch after every new thing, conceiving that poſſibly it may find Satisfaction among ſome of its Fellow Creatures. But our Enemy the Devil (who ſtrives ſtill to pervert our Gifts, and beat us with our own Weapons) hath ſo contrived it, that any Truth doth now ſeem diſtaſteful for that very reaſon, for which Error is entertain'd; Novelty. For let but ſome upſtart Hereſie be ſet abroach, and preſently there are ſome out of a curious Humour; others, as if they watched an occaſion of Singularity, will take it up for Canonical, and make it part of their Creed and Profeſſion; whereas ſolitary Truth cannot any

where find so ready Entertainment; but the same Novelty which is esteemed the Commendation of Error, and makes that acceptable; is counted the Fault of Truth, and causes that to be rejected.

How did the incredulous World gaze at *Columbus*, when he promised to discover another Part of the Earth? And he could not for a long time, by his Confidence or Arguments, induce any of the Christian Princes, either to assent unto his Opinion, or go to the Charges of an Experiment. Now if he, who had such good Grounds for his Assertion, could find no better Entertainment among the wiser Sort, and upper End of the World; 'tis not likely then that this Opinion which I now deliver, shall receive any thing from the Men of these Days; especially our Vulgar Wits, but Misbelief or Derision.

It hath always been the Unhappiness of new Truths in Philosophy, to be derided by those that are ignorant of the Causes of Things; and rejected by others, whose Perverseness ties them to the contrary Opinion; Men whose envious Pride will not allow any new Thing for Truth, which they themselves were not the first Inventors of. So that I may justly expect to be accused of a pragmatical Ignorance, and bold Ostentation; especially, since for this Opinion *Xenophanes*, a Man whose Authority was able to add some Credit to his Assertion, could not escape the like Censure from others. For *Natales Comes* speaking of that Philosopher, and this his Opinion, saith thus; *Nonnulli ne nihil scisse videantur, aliqua nova monstra in Philosophiam introducunt, ut alicujus rei inventores fuisse appareant.* "Some there are "who lest they might seem to know nothing, will "bring up monstrous Absurdities in Philosophy, "that so afterward they may be famed for the In-"vention of somewhat." The same Author doth also in another Place accuse *Anaxagoras* of Folly for the

Mythol. lib. 3. c. 17.

Lib. 7. c. 1.

the ſame Opinion. *Eſt enim non ignobilis gradus ſtultitiæ, vel ſi neſcias quid dicas, tamen velle de rebus propoſitis hanc vel illam partem ſtabilire.* "'Tis none of "the worſt kinds of Folly, boldly to affirm one "ſide or other, when a Man knows not what to ſay.

If theſe Men were thus cenſur'd, I may juſtly then expect to be derided by moſt, and to be believed by few or none; eſpecially ſince this Opinion ſeems to carry in it ſo much Strangeneſs, and Contradiction to the General Conſent of others. But however, I am reſolv'd that this ſhall not be any Diſcouragement, ſince I know that it is not common Opinion that can either add or detract from the Truth. For,

1. Other Truths have been formerly eſteemed altogether as ridiculous as this can be.

2. Groſs Abſurdities have been entertained by general Opinion.

I ſhall give an Inſtance of each, that ſo I may the better prepare the Reader to conſider Things without a Prejudice; when he ſhall ſee that the common Oppoſition againſt this which I affirm, cannot any way derogate from its Truth.

1. Other Truths have been formerly accounted as ridiculous as this. I ſhall ſpecify that of the *Antipodes*, which have been denied, and laught at by many wiſe Men and great Scholars; ſuch as were *Herodotus*, *Chryſoſtom*, *Auſtin*, *Lactantius*, the venerable *Bede*, *Lucretius* the Poet, *Procopius*, and the voluminous *Abulenſis*, together with all thoſe Fathers or other Authors who denied the Roundneſs of the Heavens. *Herodotus* counted it ſo horrible an Abſurdity, that he could not forbear laughing to think of it. Γελῶ ὁρῶν γῆς περιόδους γεγράφαντας, πολλοὺς ἤδη καὶ ἀδεναγόον ἐόντας ἐξηγησάμενον οἱ Ὠκεανόντε ῥέοντα χρόφοσι, πέριξ τωὶ τε γεωὶ ἔσαν κυκλοτερέα ὡς ἀπὸ τόρνου. "I cannot "chuſe but laugh, (ſaith he) to ſee ſo ma-"ny Men venture to deſcribe the Earths Compaſs,

Vid. Joſep. Acoſta. de nat. novi orbis, l. 1. cap. 1.

"rela-

"relating thoſe things that are without all Senſe
" as that the Sea flows about the World, and that th
" Earth it ſelf is round as an Orb." But this grea
Ignorance is not ſo much to be admired in him, a
in thoſe learneder Men of later Times, when all Sci
ences began to flouriſh in the World. Such were
St. *Chryſoſtom*, who in his 14th *Homily* upon the Epi
ſtle to the *Hebrews*, does make a Challenge to any
Man that ſhall dare to defend that the Heavens are
round, and not rather as a Tent. Thus likewiſe St.
Auſtin, who cenſures that Relation of the *Antipodes*
to be an incredible Fable; and with him agrees the
Eloquent *Lactantius*. *Quid illi qui eſſe contrarios veſtigiis noſtris Antipodes putant? num aliquid loquuntur? aut eſt quiſpiam tam ineptus, qui credat eſſe homines, quorum veſtigia ſunt ſuperiora quam capita? aut ibi quæ apud nos jacent inverſa pendere? fruges & arbores deorſum verſus creſcere, pluvias & nives, & grandinem ſurſum verſus cadere in terram? & miratur aliquis hortos penſiles inter ſeptem mira narrari, quum Philoſophi, & agros & maria, & urbes & montes penſiles faciunt, &c.*" What (ſaith he) are they that think there are
"Antipodes, ſuch as walk with their Feet againſt ours?
" do they ſpeak any likelihood; or is there any one
" ſo fooliſh as to believe that there are Men whoſe
" Heels are higher than their Heads? that things
" which with us do lie on the Ground, do hang
" there? that the Plants and Trees grow down-
" wards, that the Hail, and Rain, and Snow fall up-
" wards to the Earth? and do we admire the hang-
" ing Orchards amongſt the Seven Wonders, where-
" as here the Philoſophers have made the Fields and
" Seas, the Cities and Mountains hanging?" What
ſhall we think (ſaith he in *Plut.*) that Men do cling to
that Place like Worms, or hang by their Claws as Cats?
or if we ſuppoſe a Man a little beyond the Center,
to be digging with a Spade, is it likely (as it muſt be
according to this Opinion) that the Earth which
he

De civit. Dei l. 16. cap. 9.

Inſtitut. l. 3. c. 24.

he looſened, ſhould of it ſelf aſcend upwards? Or elſe ſuppoſe two Men with their Middles about the Center, the Feet of the one being placed where the Head of the other is, and ſo two other Men croſs them; yet all theſe Men thus ſituated, according to this Opinion ſhould ſtand upright; and many other ſuch groſs Conſequences would follow (ſaith he) which a falſe Imagination is not able to fancy as poſſible. Upon which Conſiderations, *Bede* alſo denies the Being of any Antipodes, *Neque enim Antipodarum ullatenus eſt Fabulis accommodandus aſſenſus.* "Nor ſhould we any longer aſſent to the Fable of "Antipodes." So alſo *Lucretius* the Poet ſpeaking of the ſame Subject, ſays,

De ratione temporum, Cap. 32.

Sed vanus ſtolidis hæc omnia finxerit error.

De nat. rerum Lib. 1.

That ſome idle Fancy feigned theſe for Fools to believe. Of this Opinion was *Procopius Gazæus*; but he was perſuaded to it by another kind of Reaſon; for he thought that all the Earth under us was ſunk in the Water, according to the Saying of the *Pſalmiſt, He hath founded the Earth upon the Seas*; and therefore he accounted it not inhabited by any. Nay, *Toſtatus*, a Man of later Years and general Learning, doth alſo confidently deny that there are any ſuch Antipodes, though the Reaſon which he urges for it be not ſo abſurd as the former; for the Apoſtles, ſaith he, travelled through the whole habitable World, but they never paſſed the Equinoctial: And if you anſwer, that they are ſaid to go through all the Earth, becauſe they went through all the known World; he replies, That this is not ſufficient, ſince Chriſt would have all Men to be ſaved, and come to the knowledge of his Truth, and therefore 'tis requiſite that they ſhould have travelled thither alſo, if there had been any Inhabitants; eſpecially ſince he did expreſly command them to go and teach *all Nations*, and preach the Guſpel through the *whole World*: And therefore he thinks,

Comment. in 1. *Cap. Gen.*

Pſal. 24. 2.

Comment. in 1 *Geneſ.*

1 Tim. 2. 4.

Matt. 28. 19.

thinks, that as there are no Men, ſo neither are there Seas, or Rivers, or any other Conveniency for Habitation. 'Tis commonly related of one *Virgilius*, that he was Excommunicated and Condemned for a Heretick by *Zachary* Biſhop of *Rome*, becauſe he was not of the ſame Opinion. But *Baronius* ſays, it was becauſe he thought there was another Habitable World within ours. However, you may well enough diſcern in theſe Examples, how confident many of theſe great Scholars were in ſo groſs an Error; how unlikely, what an incredible thing it ſeemed to them, that there ſhould be any Antipodes; and yet now this Truth is as certain and plain, as Senſe or Demonſtration can make it. This then which I now deliver, is not to be rejected, though it may ſeem to contradict the common Opinion.

Aventinus Annal. Boiorum. lib. 3.

Annal. Eccleſ. A. D. 748.

2. Groſs Abſurdities have been entertained by general Conſent. I might inſtance in many remarkable Examples, but I will only ſpeak of the ſuppoſed Labour of the Moon in her Eclipſes, becauſe this is neareſt to the chief Matter in Hand, and was received as a common Opinion amongſt many of the Ancients; inſomuch, that from hence they ſtiled Eclipſes by the Name of πάθη *Paſſions*, or in the Phraſe of the Poets,

Solis lunæq; labores.

And therefore *Plutarch* ſpeaking of a Lunary Eclipſe, relates, that at ſuch times 'twas a Cuſtom amongſt the *Romans*, (the moſt Civil and Learned People in the World) to ſound Braſs Inſtruments, and hold great Torches toward the Heaven. Τῶν δ' Ρωμαίων (ὥσπερ δοκεῖν ἐνομισμένον) χαλκᾶ τε πατάγοις ἀναπαλυμένων τὸ φῶς αὐτῆς καὶ πυρὰ πολλὰ δαλοῖς καὶ δᾳσὶν ἀνεχόντων πρὸς τὸν οὐρανόν. For by this means they ſuppoſed the Moon was much eaſed in her Labours; and therefore *Ovid* calls ſuch loud Inſtruments, the Auxilaries or Helps of the Moon,

In vita Paul Æmil.

Metam. Lib. 4.

Cum fruſtra reſonant æra auxiliaria Lunæ.

And

And therefore the Satyriſt too, deſcribing a loud Scold, ſays, She was able to make Noiſe enough to deliver the Labouring Moon.

Una laboranti poterit ſuccurrere Lunæ. *Juven. Sat. 6.*

Now the reaſon of all this their Ceremony, was, becauſe they feared the World would fall aſleep, when one of its Eyes began to wink, and therefore they would do what they could by loud Sounds to rouze it from its Drowſineſs, and keep it awake; by bright Torches, to beſtow that Light upon it which it began to loſe.

Some of them thought hereby to keep the Moon in her Orb, whereas otherwiſe ſhe would have fallen down upon the Earth, and the World would have loſt one of its Lights; for the credulous People believed that Inchanters and Witches could bring the Moon down; which made *Virgil* ſay,

Cantus & è cælo poſſunt deducere Lunam.

And thoſe Wizards knowing the times of her Eclipſes, would then threaten to ſhew their Skill, by pulling her out of her Orb. So that when the ſilly Multitude ſaw that ſhe began to look red, they preſently feared they ſhould loſe the Benefit of her Light, and therefore made a great noiſe that ſhe might not hear the ſound of thoſe Charms, which would otherwiſe bring her down; and this is rendred for a Reaſon of this Cuſtom by *Pliny* and *Propertius*: *Nat. Hiſt. Lib. 2. c. 12.*

Cantus & è curru lunam deducere tentant,
Et facerent, ſi non æra repulſa ſonent.

Plutarch gives another Reaſon of it; and he ſays, 'tis becauſe they would haſten the Moon out of the dark Shade wherein ſhe was involv'd, that ſo ſhe might bring away the Souls of thoſe Saints that inhabit within her, which cry out by reaſon they are then deprived of their wonted Happineſs, and cannot hear the Muſick of the Spheres; but are forced to behold the Torments and Wailings of thoſe Damned

ed Souls which are repreſented to them as they are tortured in the Region of the Air. But whether this, or whatever elſe was the meaning of this Superſtition, yet certainly 'twas a very ridiculous Cuſtom, and bewrayed a great Ignorance of thoſe ancient Times; eſpecially ſince it was not only received by the Vulgar, ſuch as were Men of leſs Note and Learning, but believed alſo by the more Famous and Wiſer Sort; ſuch as were thoſe great Poets, *Steſichorus* and *Pindar*: And not only amongſt the more ſottiſh Heathens, who might account that Planet to be one of their Gods, but the Primitive Chriſtians alſo were in this kind guilty; which made St. *Ambroſe* ſo tartly to rebuke thoſe of his time, when he ſaid, *Tum turbatur carminibus Globus Lunæ, quando calicibus turbantur & oculi.* "When your "Heads are troubled with Cups, then you think "the Moon to be troubled with Charms."

Turinenſ. Epiſc. And for this Reaſon alſo did *Maximus* a Biſhop, write a Homily againſt it, wherein he ſhewed the Abſurdity of that fooliſh Superſtition. I remember that *Ludovicus Vives* relates a more ridiculous Story of a People that impriſon'd an Aſs for drinking up the Moon, whoſe Image appearing in the Water, was covered with a Cloud as the Aſs was drinking; for which the poor Beaſt was afterward brought to the Bar, to receive a Sentence according to his Deſerts; where the grave Senate being ſet to examine the Matter, one of the Counſel (perhaps wiſer than the reſt) riſes up, and out of his deep Judgment, thinks it not fit that their Town ſhould loſe its Moon, but that rather the Aſs ſhould be cut up, and that taken out of him; which Sentence being approved by the reſt of thoſe Politicians, as the ſubtileſt way for the concluſion of the Matter, was accordingly performed. But whether this Tale were true or no, I will not queſtion; however, there is Abſurdity enough in that former Cuſtom of the Ancients, that

may

may confirm the Truth to be proved, and plainly declare the Inſufficiency of common Opinion to add true Worth or Eſtimation unto any thing. So that from that which I have ſaid, may be gathered thus much.

1. That a new Truth may ſeem abſurd and impoſſible, not only to the Vulgar, but to thoſe alſo who are otherwiſe wiſe Men and excellent Scholars: And hence it will follow, that every new thing which ſeems to oppoſe common Principles, is not preſently to be rejected, but rather to be pry'd into with a diligent Enquiry, ſince there are many things which are yet hid from us, and reſerv'd for future Diſcovery.

2. That it is not the Commonneſs of an Opinion that can privilege it for a Truth; the wrong way is ſometimes a well-beaten Path, whereas the right way (eſpecially to hidden Truths) may be leſs trodden and more obſcure.

True indeed, the ſtrangeneſs of this Opinion will detract much from its Credit; but yet we ſhould know that nothing is in it ſelf ſtrange, ſince every Natural Effect has an equal dependance upon its Cauſe, and with the like neceſſity doth follow from it; ſo that 'tis our Ignorance which makes things appear ſo: And hence it comes to paſs, that many more evident Truths ſeem incredible, to ſuch who know not the cauſes of Things. You may as ſoon perſuade ſome Country Peaſants that the Moon is made of Green Cheeſe, (as we ſay) as that 'tis bigger than his Cart-wheel, ſince both ſeem equally to contradict his ſight, and he has not Reaſon enough to lead him farther than his Senſes. Nay, ſuppoſe (ſaith *Plutarch*) a Philoſopher ſhould be educated in ſuch a ſecret Place, where he might not ſee either Sea or River, and afterwards ſhould be brought out where one might ſhew him the great Ocean, telling him the Quality of that Water, that it is brack-

iſh,

ish, salt, and not potable, and yet there were many vast Creatures of all Forms living in it, which make use of the Water as we do of the Air; questionless he would laugh at all this, as being monstrous Lyes and Fables, without any Colour of Truth. Just so will this Truth which I now deliver appear unto others, because we never dreamt of any such Matter as a World in the Moon; because the State of that Place hath as yet been vailed from our knowledge, therefore we can scarcely assent to any such Matter. Things are very hardly received, which are altogether strange to our Thoughts and our Senses. The Soul may with less difficulty be brought to believe any Absurdity, when as it has formerly been acquainted with some Colours and Probabilities for it; but when a new, and an unheard-of Truth shall come before it, though it have good Grounds and Reasons, yet the Understanding is afraid of it as a Stranger, and dares not admit it into his Belief, without a great deal of Reluctancy and Trial. And besides, things that are not manifested to the Senses, are not assented unto without some Labour of Mind, some Travel and Discourse of the Understanding; and many lazy Souls had rather quietly repose themselves in an easy Error, than take pains to search out the Truth. The strangeness then of this Opinion which I now deliver, will be a great hindrance to its Belief; but this is not to be respected, by reason it cannot be helped. I have stood the longer in the Preface, because that Prejudice which the meer Title of the Book may beget, cannot easily be removed without a great deal of Preparation; and I could not tell otherwise how to rectify the Thoughts of the Reader, for an impartial Survey of the following Discourse.

I must needs confess, though I had often thought with my self that it was possible there might be a World in the Moon, yet it seemed such an uncouth

Opini-

Opinion, that I never durſt diſcover it, for fear of being counted ſingular and ridiculous; but afterward, having read *Plutarch*, *Galileus*, *Keplar*, with ſome others, and finding many of mine own Thoughts confirmed by ſuch ſtrong Authority, I then concluded that it was not only poſſible there might be, but probable that there was another Habitable World in that Planet. In the proſecuting of this Aſſertion, I ſhall firſt endeavour to clear the way from ſuch Doubts as may hinder the ſpeed or eaſe of farther Progreſs. And becauſe the Suppoſitions imply'd in this Opinion, may ſeem to contradict the Principles of Reaſon or Faith, it will be requiſite that I firſt remove this Scruple, ſhewing the Conformity of them to both theſe, and proving thoſe Truths that may make way for the reſt; which I ſhall labour to perform in the ſecond, third, fourth, and fifth Chapters, and then proceed to confirm ſuch Propoſitions which do more directly belong to the main Point in hand.

PROP. II.

That a Plurality of Worlds doth not contradict any Principle of Reaſon or Faith.

'TIS reported of *Ariſtotle*, that when he ſaw the Books of *Moſes*, he commended them for ſuch a Majeſtick Stile as might become a God; but withal, he cenſured that manner of Writing to be very unfitting for a Philoſopher; becauſe there was nothing proved in them, but Matters were delivered as if they would rather command than perſuade Belief. And 'tis obſerved, that he ſets down nothing himſelf, but he confirms it by the ſtrongeſt Reaſons that may

be found, there being ſcarce an Argument of force for any Subject in Philoſophy, which may not be picked out of his Writings; and therefore 'tis likely if there were in Reaſon a neceſſity of one only World, that he would have found out ſome ſuch neceſſary Proof as might confirm it; eſpecially ſince he labours for it ſo much in two whole Chapters. But now all the Arguments which he himſelf urges in this Subject, are very weak, and far enough from having in them any convincing Power. Therefore 'tis likely that a Plurality of Worlds doth not contradict any Principle of Reaſon. However, I will ſet down the two chief of his Arguments from his own Works, and from them you may gueſs the force of the other.

De Cælo l. 1. c. 8,9.

Ibid. The Firſt is this: Since every heavy Body doth naturally tend downwards, and every light Body upwards, what a huddling and confuſion muſt there be, if there were two Places for Gravity, and two Places for Lightneſs? for it is probable that the Earth of that other World would fall down to this Center, and ſo mutually the Air and Fire here aſcend to thoſe Regions in the other; which muſt needs much derogate from the Providence of Nature, and cauſe a great Diſorder in his Works. But *ratio hæc eſt minimè firma*, (ſaith *Zanchy*.) And if you well conſider the Nature of Gravity, you will plainly ſee there is no Ground to fear any ſuch Confuſion; for Heavineſs is nothing elſe but ſuch a Quality as cauſes a Propenſion in its Subject to tend downwards towards its own Centre: So that for ſome of that Earth to come hither, would not be ſaid a Fall, but an Aſcenſion, ſince it is moved from its own Place; and this would be impoſſible (ſaith *Ruvio*) becauſe againſt Nature, and therefore no more to be feared than the falling of the Heavens.

De operibus Dei, par. 2. lib. 2. cap. 2.

De Cælo l. 1. c. 9. q. 1.

If you reply, that then according to this, there muſt be more Centres of Gravity than one; I anſwer, 'Tis very probable there are; nor can we well conceive what any piece of the Moon would do, being ſevered from the reſt in the free and open Air, but only return unto it again.

Another Argument he had from his Maſter *Plato*, That there is but one World, becauſe there is but one firſt Mover, God. *Metaphyſ. l.* 12. *c.* 8. *Diog. Laert. lib.* 3.

Infirma etiam eſt hæc ratio (ſaith *Zanchy*); and we may juſtly deny the Conſequence, ſince a Plurality of Worlds doth not take away the unity of the firſt Mover, *Ut enim forma ſubſtantialis, ſic primum efficiens apparentem ſolummodo multiplicitatem induit per ſignatam materiam* (ſaith a Countryman of ours.) As the ſubſtantial Form, ſo the efficient Cauſe hath only an appearing Multiplicity from its particular Matter. You may ſee this Point more largely handled, and theſe Arguments more fully anſwered by *Plutarch* in his Book, *Why Oracles are Silent*, and *Jacob Carpentarius* in his Comment on *Alcinous*. *Nic. Hill. de Philoſoph. Epic. part. tit.* 379.

But our Oppoſites, the Interpreters themſelves, (who too often do *jurare in verba magiſtri*) will grant that there is not any ſtrength in theſe Conſequences; and certainly then ſuch weak Arguments could not convince that wiſe Philoſopher, who in his other Opinions was wont to be ſwayed by the ſtrength and power of Reaſon; wherefore I ſhould rather think that he had ſome by-reſpect, which made him firſt aſſent to this Opinion, and afterwards ſtrive to prove it. Perhaps it was becauſe he feared to diſpleaſe his Scholar *Alexander*; of whom 'tis related, that he wept to hear a Diſputation of another World, ſince he had not then attained the Monarchy of this; his reſtleſs wide Heart would have eſteemed this Globe of Earth not big enough for him, if there had been another; which made the Satyriſt ſay of him, *Plutarch. de tranq. anim.*

Juvenal. *Æstuat infœlix angusto limite mundi.*

" That he did vex himself, and sweat in his Desires, " as being penn'd up in a narrow Room, when he " was confin'd but to one World." Before, he thought to seat himself next the Gods, but now, when he had done his best, he must be content with some equal, or perhaps superior Kings.

It may be, that *Aristotle* was moved to this Opinion, that he might thereby take from *Alexander* the occasion of this Fear and Discontent; or else, perhaps, *Aristotle* himself was as loth to hold the Possibility of a World which he could not discover, as *Alexander* was to hear of one which he could not conquer. 'Tis likely that some such by-respect moved him to this Opinion, since the Arguments he urges for it are confess'd by his zealous Followers and Commentators, to be very slight and frivolous; and they themselves grant, what I am now to prove, that there is not any Evidence in the Light of Natural Reason, which can sufficiently manifest that there is but one World.

But however, some may object, Would it not be inconvenient and dangerous to admit of such Opinions that do destroy those Principles of *Aristotle* which all the World hath so long followed?

Apologia pro Galileo. This Question is much controverted by some of the *Romish* Divines: *Campanella* hath writ a Treatise in Defence of it, in whom you may see many things worth the Reading and Notice.

To it I answer, That this Position in Philosophy doth not bring any Inconveniency to the rest, since 'tis not *Aristotle*, but Truth, that should be the Rule of our Opinions; and if they be not both found together, we may say to him, as he said to his Master *Plato*,

Ethic. l. 1. c. 6. " Though *Plato* were his Friend, yet he would ra- " ther adhere to Truth than him.

I must

I muſt needs grant, that we are all much beholden to the Induſtry of the ancient Philoſophers, and more eſpecially to *Ariſtotle*, for the greater part of our Learning; but yet 'tis not Ingratitude to ſpeak againſt him, when he oppoſeth Truth; for then many of the Fathers would be very guilty, eſpecially *Juſtin*, who hath writ a Treatiſe purpoſely againſt him. But ſuppoſe this Opinion were falſe, yet 'tis not againſt the Faith, and ſo it may ſerve for the better Confirmation of that which is true; the Sparks of Error being forc'd out by oppoſition, as the Sparks of Fire by the ſtriking of the Flint and Steel. But ſuppoſe too that it were Heretical, and againſt the Faith, yet may it be admitted with the ſame Privilege as *Ariſtotle*, from whom many more dangerous Opinions have proceeded: As that the World is Eternal; that God cannot have while to look after theſe inferior Things; that after Death there is no Reward or Puniſhment, and ſuch like Blaſphemies; which ſtrike directly at the Fundamentals of our Religion.

So that it is juſtly to be wonder'd, why ſome ſhould be ſo ſuperſtitious in theſe Days, as to ſtick cloſer unto him, than unto Scripture, as if his Philoſophy were the only Foundation of all Divine Truths.

Upon theſe Grounds, both St. *Vincentius* and *Serafinus de Firmo* (as I have ſeen them quoted) think that *Ariſtotle* was the Viol of God's Wrath, which was poured out upon the Waters of Wiſdom by the third Angel: But for my part, I think the World is much beholden to him for all his Sciences. But yet 'twere a ſhame for theſe later Ages, to reſt our ſelves meerly upon the Labours of our Fore fathers, as if they had informed us of all things to be known; and when we are ſet upon their Shoulders, not to ſee further than they themſelves did. 'Twere a ſuperſtitious, a lazy Opinion, to think *Ariſtotle*'s Works the Bounds and Limits of all Human Invention, be- Rev. 16. 4.

yond which there could be no poſſibility of reaching. Certainly there are yet many things left to Diſcovery, and it cannot be any Inconveniency for us to maintain a new Truth, or rectifie an ancient Error.

But the Poſition (ſay ſome) is directly againſt Scripture; for,

1. *Moſes* tells us but of one World, and his Hiſtory of the Creation had been very imperfect, if God had made another.

2. St. *John* ſpeaking of God's Works, ſays, he made the World, in the ſingular Number, and therefore there is but one. 'Tis the Argument of *Aquinas*, and he thinks that none will oppoſe it, but ſuch who with *Democritus* eſteem ſome blind Chance, and not any wiſe Providence, to be the Framer of all Things.

Part 1. Q. 47. *Art.* 3.

3. The Opinion of more Worlds has in ancient Times been accounted a Hereſie; and *Baronius* affirms that for this very Reaſon *Virgilius* was caſt out of his Biſhoprick, and Excommunicated from the Church.

Annal. Eccl. A. D. 748.

4. A fourth Argument there is urged by *Aquinas*: If there be more Worlds than one, then they muſt either be of the ſame, or of a diverſe Nature; but they are not of the ſame kind; for this were needleſs, and would argue an Improvidence, ſince one would have no more perfection than the other: Not of divers kinds; for then one of them could not be called the World or Univerſe, ſince it did not contain univerſal Perfection. I have cited this Argument, because it is ſo much ſtood upon by *Julius Cæſar la Galla*, one that has purpoſely writ a Treatiſe againſt this Opinion which I now deliver; but the Dilemma is ſo blunt, that it cannot cut on either ſide, and the Conſequences ſo weak, that I dare truſt them without an Anſwer: And (by the way) you may ſee this later Author in that place, where he endea-

Ibid.

De Phenom. in orbe Lunæ.

endeavours to prove a Neceſſity of one World, doth leave the chief Matter in hand, and take much needleſs Pains to diſpute againſt *Democritus*, who thought that the World was made by the caſual Concourſe of *Atoms* in a great *Vacuum*. It ſhould ſeem that either his Cauſe or his Skill was weak, or elſe he would have ventured upon a ſtronger Adverſary. Theſe Arguments which I have ſet down are the chiefeſt which I have met with againſt this Subject; and yet the beſt of theſe hath not force enough to endanger the Truth that I have delivered.

Unto the two firſt it may be anſwered, that the negative Authority of Scripture is not prevalent in thoſe things which are not the Fundamentals of Religion.

But you'll reply, though it do not neceſſarily conclude, yet 'tis probable if there had been another World, we ſhould have had ſome notice of it in Scripture.

I anſwer, 'tis as probable that the Scripture ſhould have informed us of the Planets, they being very remarkable Parts of the Creation; and yet neither *Moſes*, nor *Job*, nor the *Pſalms* (the Places moſt frequent in Aſtronomical Obſervations) nor any other Scripture mention any of them but the Sun and Moon. Becauſe the Difference betwixt them and the other Stars, was known only to thoſe who were learned Men, and had Skill in *Aſtronomy*. As for that Expreſſion in *Job* כוכבי בקר *the Stars of the Morning*, it is in the Plural Number, and therefore cannot properly be applied to *Venus*. And for that in *Iſaiah* הילל, 'tis confeſſed to be a Word of obſcure Interpretation, and therefore is but by gueſs tranſlated in that Senſe. It being a true and common Rule, that *Hebræi rei ſideralis minime curioſi cœleſtium nominum penuriâ laborant*. The *Jews* being but little skilled in Aſtronomy, their Language does want proper Expreſſions for the Heavenly Bodies; and therefore they are

Job 38. 7. Iſa. 14. 12. *Fromond. Veſta t.* 3. *cap.* 2. So 2 Reg. 23. 5. מולות Which is interpreted both for the Planets & for the 12 Signs.

are fain ſometimes to attribute the ſame Name unto divers Conſtellations.

Now if the Holy Ghoſt had intended to reveal unto us any natural Secrets, certainly he would never have omitted the mention of the Planets, *Quorum motu nihil eſt quod de Conditoris ſapientiâ teſtatur evidentius apud eos qui capiunt.* Which do ſo evidently ſet forth the Wiſdom of the Creator. And therefore you muſt know that 'tis beſides the Scope of the Old Teſtament or the New, to diſcover any thing unto us concerning the Secrets of Philoſophy. 'Tis not his intent in the New Teſtament, ſince we cannot conceive how it might any way belong either to the Hiſtorical, Exegetical, or Prophetical Parts of it: Nor is it his intent in the Old Teſtament, as is well obſerved by our Country-man Maſter *Wright*. *Non Moſis aut Prophetarum inſtitutum fuiſſe videtur Mathematicas aliquas aut Phiſicas ſubtiltates promulgare ſed ad vulgi captum & loquendi morem, quemadmodum nutrices infantulis ſolent, ſeſe accommodare.* "'Tis not the Endeavour of *Moſes* "or the Prophets to diſcover any Mathematical or "Philoſophical Subtilties; but rather to accommodate "themſelves to Vulgar Capacities, and ordinary "Speech, as Nurſes are wont to uſe their Infants." True indeed, *Moſes* is there to handle the Hiſtory of the Creation. But 'tis certain (ſaith *Calvin*) that his Purpoſe is to treat only of the viſible Form of the World, and thoſe Parts of it which might be moſt eaſily underſtood by the ignorant and ruder Sort of People, and therefore we are not thence to expect the Diſcovery of any natural Secret. *Artes reconditas aliunde diſcat qui volet; hic ſpiritus Dei omnes ſimul ſine exceptione docere voluit.* As for more hidden Arts, they muſt be looked for elſewhere; the Holy Ghoſt did here intend to inſtruct all without Exception. And therefore 'tis obſerved, that *Moſes* does not any where meddle with ſuch Matters as were very hard to be conceived; for being to inform the common Peo-

Keplar. introduct. in Mart.

In Epiſt. ad Gilbert.

Calvin in 1. Gen.

People as well as others, he does it after a Vulgar Way, as it is commonly noted, declaring the Original chiefly of thoſe things which are obvious to the Senſe; and being ſilent of other things which then could not well be apprehended. And therefore *Pererius* propoſing the Queſtion, why the Creation of Plants and Herbs is mentioned, but not of Metals and Minerals?

Com. in 1. *Gen.* 11.

Anſwers: *Quia iſtarum rerum generatio eſt vulgo occulta & ignota*: Becauſe theſe things are not ſo commonly known as the other; and he adds, *Moſes non omnia, ſed manifeſta omnibus enarranda ſuſcepit. Moſes* did not intend to relate unto us the Beginnings of all things, but thoſe only which were moſt evident unto all Men. And therefore too, *Aquinas* obſerves, that he writes nothing of the Air; becauſe that being inviſible, the People knew not whether there were any ſuch Body or no. And for this very reaſon St. *Jerom* alſo thinks that there is nothing expreſt concerning the Creation of Angels; becauſe the rude and ignorant Vulgar were not ſo capable of apprehending their Natures. And yet notwithſtanding, theſe are as remarkable Parts of the Creation, and as fit to be known as another World. And therefore the Holy Ghoſt too, uſes ſuch vulgar Expreſſions, which ſet things forth rather as they appear than as they are, as when he calls the Moon *one of the greater Lights*, whereas 'tis the leaſt that we can ſee in the whole Heavens. So afterwards ſpeaking of the great Rain which drowned the World; he ſays, The Windows of Heaven were opened, becauſe it ſeemed to come with that Violence, as if it were poured out from Windows in the Firmament.

Part 1. *Q.* 68. *Art.* 3.

Epiſt. 139. *ad Cypri.* So *Pererius in* 2 *Gen.*

Gen. 1. 16.

Gen. 11. Mal. 3. 10.

Sir *Walter Rawl.* c. 7. Sect. 6.

And in reference to this, a Drowth is deſcribed in ſundry other * Places by *the Heavens being ſhut up*. So that the Phraſes which the Holy Ghoſt uſes concerning theſe things, are not to be underſtood in a literal Senſe;

*Deut. 11. 17. 1 Reg. 3. 55. Luk. 4. 25.

Senſe; but rather as vulgar Expreſſions; and this Rule is ſet down by St. *Auſtin*, where ſpeaking concerning that in the *Pſalm*, *who ſtretched the earth upon the waters*, he notes, that when the Words of Scripture ſhall ſeem to contradict common Senſe or Experience, there are they to be underſtood in a qualified Senſe, and not according to the Letter. And 'tis obſerved, that for want of this Rule, ſome of the Ancients have faſten'd ſtrange Abſurdities upon the Words of the Scripture. So St. *Ambroſe* eſteemed it a Hereſy to think that the Sun and Stars were not very hot, as being againſt the Words of Scripture, *Pſalm* 19. 6. where the *Pſalmiſt* ſays, that there is nothing that is hid from the Heat of the Sun. So others there are that would prove the Heavens not to be round, out of that Place, *Pſal.* 104. 2. *He ſtretched out the heavens like a curtain.* So *Procopius* alſo was of Opinion, that the Earth was founded upon the Waters; nay, he made it part of his Faith, proving it out of *Pſal.* 24. 2. *He hath founded the earth upon the ſeas, and eſtabliſhed it upon the floods.* Theſe and ſuch like Abſurdities have followed, when Men look for the Grounds of Philoſophy in the Words of Scripture. So that, from what hath been ſaid, I may conclude that the Silence of Scripture concerning any other World, is not ſufficient Argument to prove that there is none. Thus for the 2 firſt Arguments.

L 2. in Gen. Pſa. 136. 6.

Hexamer lib. 2. Item Baſil. Hom. 3. in Geneſ.

Wiſd. 2. 4. 17. 5. Ecclus. 43. 3, 4. *Com. in c.* 1. *Gen.*

Unto the third, I may anſwer, that this very Example is quoted by others, to ſhew the Ignorance of thoſe Primitive Times, who did ſometimes condemn what they did not underſtand; and have often cenſur'd the lawful and undoubted Parts of Mathematicks for Heretical, becauſe they themſelves could not perceive a Reaſon of it. And therefore their Practice in this particular is no ſufficient Teſtimony againſt us.

But laſtly, I anſwer to all the above-named Objections, that the Term (*World*) may be taken in a double

double Senſe, more generally for the whole Univerſe, as it implies in it the Elementary and Æthereal Bodies, the Stars and the Earth. Secondly, more particularly for an inferior World, conſiſting of Elements.

Now the main drift of all theſe Arguments, is to confute a Plurality of Worlds in the firſt Senſe; and if there were any ſuch, it might (perhaps) ſeem ſtrange, that *Moſes* or St. *John* ſhould either not know, or not mention its Creation. And *Virgilius* was condemned for this Opinion, becauſe he held *quod ſit alius mundus ſub terrà, aliuſque Sol & Luna,* (as *Baronius*) that within our Globe of Earth, there was another World, another Sun and Moon, and ſo he might ſeem to exclude this from the Number of the other Creatures.

But now, there is no ſuch danger in this Opinion, which is here delivered; ſince this World is ſaid to be in the Moon, whoſe Creation is particularly expreſs'd.

So that in the firſt Senſe, I yield that there is but one World, which is all that the Arguments do prove; but underſtand it in the ſecond Senſe, and ſo I affirm there may be more, nor do any of the above-named Objections prove the contrary.

Neither can this Opinion derogate from the Divine Wiſdom (as *Aquinas* thinks) but rather advance it, ſhewing a *compendium* of Providence, that could make the ſame Body a World, and a Moon; a World for Habitation, and a Moon for the uſe of others, and the Ornament of the whole Frame of Nature. For as the Members of the Body ſerve not only for the Preſervation of themſelves, but for the Uſe and Conveniency of the whole, as the Hand protects the Head as well as ſaves it ſelf; ſo is it in the Parts of the Univerſe, where each one may ſerve as well for the Conſervation of that which is within it, as the Help of others without it. *Cuſanus de doct. ignor. l. 2. c. 12.*

Mer-

Comment. in Gen. Qu. 19. *Art.* 2.

Merſennus a late Jeſuit, propoſing the Queſtion whether or no the Opinion of more Worlds than one, be heretical and againſt the Faith? He anſwers it negatively; becauſe it does not contradict any Expreſs Place of Scripture, or Determination of the Church. And though (ſaith he) it ſeems to be a raſh Opinion, as being againſt the Conſent of the Fathers; yet if this Controverſy be chiefly Philoſophical, then their Authorities are not of ſuch Weight. Unto this it may be added, that the Conſent of the Fathers is prevalent only in ſuch Points as were firſt controverted amongſt them, and then generally decided one way, and not in ſuch other Particulars as never fell under their Examination and Diſpute.

I have now in ſome meaſure, ſhewed that a Plurality of Worlds does not contradict any Principle of Reaſon or Place of Scripture; and ſo cleared the firſt part of that Suppoſition which is implied in the Opinion.

It may next be enquired, whether 'tis poſſible there may be a Globe of Elements in that which we call the Æthereal Parts of the Univerſe; for if this (as it is according to the common Opinion) be privileged from any Change or Corruption, it will be in vain then to imagine any Element there; and if we will have another World, we muſt then ſeek out ſome other Place for its Situation. The Third Propoſition therefore ſhall be this.

PROP.

PROP. III.

That the Heavens do not consist of any such pure Matter, which can privilege them from the like Change and Corruption as these Inferior Bodies are liable unto.

IT hath been often questioned amongst the ancient Fathers and Philosophers, what kind of Matter that should be of which the Heavens are framed. Some think that they consist of a fifth Substance distinct from the four Elements, as *Aristotle* holds, and with him some of the late Schoolmen; whose subtil Brains could not be content to attribute to those vast Glorious Bodies, but common Materials, and therefore they themselves had rather take pains to prefer them to some extraordinary Nature; whereas notwithstanding, all the Arguments they could invent, were not able to convince a Necessity of any such Matter, as is confess'd by their own * side. It were much to be desired, that these Men had not in other Cases, as well as this, multiplied things without Necessity; and, as if there had not been enough to be known in the Secrets of Nature, have spun out new Subjects from their own Brains, to find more Work for future Ages. I shall not mention their Arguments, since 'tis already confess'd, that they are none of them of any necessary Consequence; and besides, you may see them set down in any of the Books *de Cælo*.

De Cælo li. 1. cap. 2.

* *Colleg. Connimb. de cælo. l. 1. c. 2. q. 6. art. 3.*

But it is the general Consent of the Fathers, and the Opinion of *Lombard*, that the Heavens consist of the same Matter with these Sublunary Bodies. St. *Ambrose* is so confident of it, that he esteems the contrary a Heresie. True indeed they differ much among themselves, some thinking them to be made of Fire, others of Water, and others of both; But herein they generally

In Hexam. lib. 4.

generally agree, That they are all framed of ſome Element or other; which *Dionyſius Carthuſianus* collects from that Place in *Geneſis*, where the Heavens are mentioned in their Creation, as divided only in diſtance from the Elementary Bodies, and not as being made of any new Matter. To this purpoſe others cite the Derivation of the *Hebrew* Word שמים, *quaſi* שם *ibi &* מים *aquæ* or *quaſi* אש *ignis &* מים *aquæ*. Becauſe they are framed out of theſe Elements. But concerning this, you may ſee ſundry Diſcourſes more at large in *Ludovicus Molina*, *Euſebius Nirembergius*, with divers others. The Venerable *Bede* thought the Planets to conſiſt of all the four Elements; and 'tis likely that the other Parts of it are of an Aereous Subſtance, as will be ſhewed afterward: However, I cannot now ſtand to recite the Arguments for either; I have only urged theſe Authorities to countervail *Ariſtotle* and the Schoolmen, and the better to make way for a Proof of their Corruptibility.

Enarrat in Geneſ. art. 10.

In operc. 6. dierum. diſput. 5.

In lib. de Mundi conſtit.

The next thing then to be enquired after, is, Whether they be of a Corruptible Nature; not whether they can be deſtroyed by God; for this Scripture puts out of doubt.

2 Pet. 3. 12.

Nor whether or no in a long time they would wear away and grow worſe, for from any ſuch fear they have been lately privileged. But whether they are capable of ſuch Changes and Viciſſitudes, as this inferior World is liable unto.

By Doctor *Hakewill. Apol. lib.* 2.

The two chief Opinions concerning this, have both erred in ſome Extremity, the one ſide going ſo far from the other, that they have both gone beyond the right; whilſt *Ariſtotle* hath oppoſed the Truth as well as the Stoicks.

Some of the Ancients have thought, that the Heavenly Bodies have ſtood in need of Nouriſhment from the Elements, by which they were continually fed, and ſo had divers Alterations by reaſon of their Food. This is fathered on *Heraclitus*, followed by that great Natu-

Nateraliſt *Pliny*, and in general attributed to all the Stoicks. You may ſee *Seneca* expreſly to this purpoſe in theſe Words. *Ex illa alimenta omnibus animalibus, omnibus ſatis, omnibus ſtellis dividuntur; hinc profertur quo ſuſtineantur tot Sidera tam exercitata, tam avida, per diem, noctemque, ut in opera, ita in paſtu.* Speaking of the Earth, he ſays, from thence it is that Nouriſhment is divided to all the Living Creatures, the Planets and the Stars; hence were ſuſtained ſo many Conſtellations, ſo laborious, ſo greedy, both Day and Night, as well in their Feeding as Working. Thus alſo *Lucan* ſings,

Plutarch de plac. Philoſ. l. 2. c. 17. Nat. Hiſt. l. 2. c, 9. Nat. queſt. lib. 2. cap. 5.

Necnon Oceano paſci Phœbumque polumque Credimus.

Unto theſe, *Ptolomy* alſo, that Learned *Egyptian*, ſeemed to agree, when he affirms that the Body of the Moon is moiſter and cooler than any of the other Planets, by reaſon of the Earthly Vapours that are exhaled unto it. You ſee theſe Ancients thought the Heavens to be ſo far from this imagined Incorruptibility, that rather like the weakeſt Bodies they ſtood in need of ſome continual Nouriſhment, without which they could not ſubſiſt.

1. *Apoſtol.*

But *Ariſtotle* and his Followers were ſo far from this, that they thought thoſe Glorious Bodies could not contain in them any ſuch Principles as might make them liable to the leaſt Change or Corruption; and their chief Reaſon was, becauſe we could not in ſo long a ſpace diſcern any Alteration amongſt them. But unto this I anſwer:

De Cælo l. 1. c. 3.

1. Suppoſing we could not, yet would it not hence follow that there were none, as he himſelf in effect doth confeſs in another place; for ſpeaking concerning our Knowledge of the Heavens, he ſays, 'Tis very imperfect and difficult, by reaſon of the vaſt diſtance of thoſe Bodies from us, and becauſe the Changes which may happen unto them, are not either big enough, or frequent enough to fall within the Apprehenſion and Obſervation of our Senſes; no wonder then,

De cælo, l. 2. cap. 5.

then, if he himſelf be deceived in his Aſſertions concerning theſe Particulars. But yet, in this he implies, that if a Man were nearer to theſe Heavenly Bodies, he would be a fitter Judge to decide this Controverſie than himſelf. Now it is our Advantage, that by the help of *Galileus*'s Glaſs, we are advanced nearer unto them, and the Heavens are made more preſent to us than they were before. However, as it is with us, where there be many Viciſſitudes and Succeſſions of Things, though *the Earth abideth for ever*; ſo likewiſe may it be amongſt the Planets; in which, though there ſhould be divers Alterations, yet they themſelves may ſtill continue of the ſame Quantity and Light.

2. Though we could not by our Senſes ſee ſuch Alterations, yet our Reaſon might perhaps ſufficiently convince us of them. Nor can we well conceive how the Sun ſhould reflect againſt the Moon, and yet not produce ſome Alteration of Heat. *Diogenes* the Philoſopher was hence perſuaded, that thoſe ſcorching Heats had burnt the Moon into the form of a Pumice-ſtone.

3. I anſwer, That there have been ſome Alterations obſerved there; witneſs thoſe Comets which have been ſeen above the Moon; as alſo thoſe Spots or Clouds that encompaſs the Body of the Sun; amongſt which, there is a frequent Succeſſion by a Corruption of the old, and a Generation of new. So that tho' *Ariſtotle*'s Conſequence were ſufficient, when he proved that the Heavens were not Corruptible, becauſe there have not any Changes been diſcovered in it; yet this by the ſame Reaſon muſt be as prevalent, that the Heavens are Corruptible, becauſe there have been ſo many Alterations obſerved there. But of theſe, together with a farther Confirmation of this Propoſition, I ſhall have occaſion to ſpeak afterwards: In the mean ſpace, I will refer the Reader to that Work of *Scheiner*, a late Jeſuit, which he Titles his *Roſa Urſina*, where he may ſee this Point concerning the Corruptibility

Lib. 4. par. 2. cap. 24. 35.

bility of the Heavens largely handled, and sufficiently confirmed.

There are some other things, on which I might here take an occasion to enlarge my self; but because they are directly handled by many others, and do not immediately belong to the chief Matter in hand, I shall therefore refer the Reader to their Authors, and omit any large Proof of them my self, as desiring all possible Brevity.

1. The first is this: That there are no solid Orbs. If there be a Habitable World in the Moon, (which I now affirm) it must follow, that her Orb is not solid, as *Aristotle* supposed; and if not hers, why any of the other? I rather think that they are all of a fluid (perhaps aereous) Substance. St. *Ambrose* and St. *Basil* did endeavour to prove this out of that Place in *Isaiah*, where they are compared to Smoak, as they are both quoted by *Rhodiginus*. *Eusebius Nierembergus* doth likewise from that place, confute the Solidity and Incorruptibility of the Heavens, and cites for the same Interpretation the Authority of *Eustachius* of *Antioch*; and St. *Austin*, I am sure, in one Place seems to assent unto this Opinion, though he does often in his other Works contradict it.

Isa. 51. 6.
Ant. lect. l. 1. c. 4.
Hist. nat. l. 2. c. 11. 13.
In lib. sup. Gen. ad lit.

If you esteem the *Testimony* of the Ancient Fathers, to be of any great Force or Consequence in a Philosophical Dispute, you may see them to this purpose in *Sixtus Senensis*, *Lib.* 5. *Biblioth. Annot.* 14. The chief Reasons that are commonly urged for the Confirmation of it, are briefly these Three.

1. From the Altitude of divers Comets, which have been observed to be above the Planets; through whose Orbs (if they had been solid) there would not have been any Passage. To these may be added those lesser Planets lately discovered about *Jupiter* and *Saturn*, for which Astronomers had not yet framed any Orbs.

2. 2. From that uncertainty of all Aſtronomical Obſervations, which will follow upon the Suppoſition of ſuch ſolid Spheres. For then we ſhould never diſcern any Star, but by a Multitude of Refractions, and ſo conſequently we could not poſſibly find their true Situations, either in reſpect of us, or in regard of one another: Since whatever the Eye diſcerns by a refracted Beam, it apprehends to be in ſome other Place than wherein it is. But now this would be ſuch an Inconvenience, as would quite ſubvert the Grounds and whole Art of Aſtronomy, and therefore is by no Means to be admitted.

Unto this it is commonly anſwered, That all thoſe Orbs are equally Diaphanous, though not of a continued Quantity. We reply, That ſuppoſing they were, yet this cannot hinder them from being the Cauſes of Refraction, which is produced as well by the Diverſity of Superficies, as the different Perſpicuity of Bodies. Two Glaſſes put together, will cauſe a diverſe Refraction from another ſingle one, that is but of equal Thickneſs and Perſpicuity.

3. 3. From the different height of the ſame Planet at ſeveral times. For, if according to the uſual *Hypotheſis*, there ſhould be ſuch diſtinct, ſolid Orbs, then it would be impoſſible that the Planets ſhould intrench upon one another's Orbs, or that two of them at ſeveral times ſhould be above one another, which notwithſtanding hath been proved to be ſo by later Experience. *Tycho* hath obſerved, that *Venus* is ſometimes nearer to us than the *Sun* or *Mercury*, and ſometimes farther off than both: Which Appearances *Regiomontanus* himſelf does acknowledge, and withal, does confeſs that they cannot be reconciled to the common *Hypotheſis*.

But for your better ſatisfaction herein, I ſhall refer you to the above-named *Scheiner*, in his *Roſa Urſina*, in whom you may ſee both Authorities and Reaſon very largely and diſtinctly ſet down for this Opinion. For the better Confirmation of which, he adjoins alſo

Lib.4.p.11. 2.c.7.26. 30.

ſome

ſome Authentical Epiſtles of *Fredericus Cæſius Lynceus*, a Noble Prince, written to *Bellarmine*, containing divers Reaſons to the ſame purpoſe. You may alſo ſee the ſame Truth ſet down by *Johannes Pena*, in his Preface to *Euclid*'s *Opticks*, and *Chriſtoph. Rothmannus*, both who thought the Firmament to be only Air; and tho' the noble *Tycho* do diſpute againſt them, yet he himſelf holds, *Quod propius ad veritatis penetralia accedit hæc opinio, quam Ariſtotelica vulgariter approbata, quæ cœlum pluribus realibus atque imperviis orbibus citra rem replevit.* *De ſtell.* 1. 15,72. *l.* 2. *c.* 9.

" That this Opinion comes nearer to the Truth, than " that common one of *Ariſtotle*, which hath to no " purpoſe filled the Heavens with ſuch real and im- " pervious Orbs.

2. There is no Element of Fire, which muſt be held with this Opinion here delivered; for if we ſuppoſe a World in the Moon, then it will follow, that the Sphere of Fire either is not there, where 'tis uſually placed in the Concavity of his Orb, or elſe that there is no ſuch thing at all; which is moſt probable, ſince there are not any ſuch ſolid Orbs, that by their ſwift Motion might heat and enkindle the adjoining Air, which is imagined to be the reaſon of that Element. The Arguments that are commonly urged to this purpoſe, are theſe.

1. That which was before alledged concerning the Refractions which will be cauſed by a different Medium. For if the Matter of the Heavens be of one thickneſs, and the Element of Fire another, and the upper Region of Air diſtinct from both theſe, and the lower Region ſeveral from all the reſt; there will then be ſuch a Multiplicity of Refractions, as muſt neceſſarily deſtroy the Certainty of all Aſtronomical Obſervations. All which Inconveniences might be avoided, by ſuppoſing (as we do) that there is only one Orb of Vaporous Air which encompaſſes our Earth, all the reſt being *Æthereal*, and of the ſame Perſpicuity. 1.

2. 2. The Situation of this Element does no way agree with *Ariſtotle*'s own Principles, or that common Providence of Nature, which we may diſcern in ordinary Matters. For if the Heavens be without all Elementary Qualities, as is uſually ſuppoſed, then it would be a very incongruous thing for the Element of Fire to be placed immediately next unto it; ſince the heat of this is the moſt powerful and vigorous Quality that is among all the reſt: And Nature in her Works, does not join Extremes, but by ſomething of a middle Diſpoſition. So in the very Frame of our Bodies, the Bones which are of a hard Subſtance, and the Fleſh of a ſoft, are not joined together but by the Interceſſion of Membranes and Griſles, ſuch as being of a middle Nature may fitly come betwixt.

3. 3. 'Tis not conceiveable for what Uſe or Benefit there ſhould be any ſuch Element in that place; and certain it is, that Nature does not do any thing in vain.

4. 4. Betwixt two Extreams there can be but one Medium; and therefore between thoſe two oppoſite Elements of Earth and Water, it may ſeem more convenient to place only the Air, which ſhall partake of middle Qualities different from both.

5. 5. Fire does not ſeem ſo properly and directly to be oppoſed to any thing as Ice; and if the one be not an Element, why ſhould the other?

If you object, that the Fire which we commonly uſe does always tend upwards; I anſwer, This cannot prove that there is a Natural Place for ſuch an Element, ſince our Adverſaries themſelves do grant, that *Culinary* and *Elementary* Fire are of different kinds. The one does burn, ſhine, and corrupt its Subject; the other diſagrees from it in all theſe Reſpects. And therefore from the Aſcent of the one, we cannot properly infer the Being or Situation of the other.

But for your farther Satisfaction herein, you may peruſe *Cardan*, *Johannes Pena*, that Learned *Frenchman*

man the Noble *Tycho*, with divers others who have purpoſely handled this Propoſition.

3. I might add a Third, *viz.* That there is no Muſick of the Spheres; for if they be not ſolid, how can their Motion cauſe any ſuch Sound as is conceived? I do the rather meddle with this, becauſe *Plutarch* ſpeaks as if a Man might very conveniently hear that Harmony, if he were an Inhabitant in the Moon. But I gueſs that he ſaid this out of Incogitancy, and did not well conſider thoſe neceſſary Conſequences which depend upon his Opinion. However, the World would have no great loſs in being depriv'd of this Muſick, unleſs at ſome times we had the privilege to hear it: Then indeed *Philo* the *Jew* thinks it would ſave us the Charges of Diet, and we might live at an eaſy rate by feeding at the Ear only, and receiving no other Nouriſhment; and for this very Reaſon (ſays he) was *Moſes* enabled to tarry Forty Days and Forty Nights in the Mount without eating any thing, becauſe he there heard the Melody of the Heavens. ——*Riſum teneatis.* I know this Muſick hath had great Patrons, both Sacred and Prophane Authors, ſuch as *Ambroſe*, *Bede*, *Boetius*, *Anſelm*, *Plato*, *Cicero*, and others; but becauſe it is not now, I think, affirmed by any, I ſhall not therefore beſtow either Pains or Time in arguing againſt it. 3. *De ſomniis.*

It may ſuffice that I have only named theſe three laſt, and for the two more neceſſary, have referred the Reader to others for ſatisfaction. I ſhall in the next place proceed to the Nature of the Moon's Body, to know whether that be capable of any ſuch Conditions, as may make it poſſible to be inhabited, and what thoſe Qualities are wherein it more nearly agrees with our Earth.

PROP. IV.

That the Moon is a Solid, Compacted, Opacous Body.

I Shall not need to ſtand long in the proof of this Propoſition, ſince it is a Truth already agreed on by the general Conſent of the moſt and the beſt Philoſophers.

1, 1. It is ſolid, in oppoſition to fluid, as is the Air; for how otherwiſe could it beat back the Light which it receives from the Sun?

But here it may be queſtion'd, whether or no the Moon beſtow her Light upon us by the Reflection of the Sun-beams from the Superficies of her Body, or elſe by her own Illumination? Some there are who affirm this latter Part. So * *Averroes*, † *Cælius Rhodiginus*, &c. *Julius Cæſar*, &c. And their Reaſon is, becauſe this Light is diſcerned in many Places, whereas thoſe Bodies which give Light by Reflexion, can there only be perceived where the Angle of Reflexion is equal to the Angle of Incidence, and this is only in one Place; as in a Looking-glaſs, thoſe Beams which are reflected from it, cannot be perceived in every Place where you may ſee the Glaſs, but only there where your Eye is placed on the ſame Line whereon the Beams are reflected.

* *De cælo l.* 2. *com.* 49.
† *Ant. lection. l.* 20. *c.* 4.
‡ *De phænom. Lunæ. c.* 11.

But to this I anſwer, That the Argument will not hold of ſuch Bodies whoſe Superficies is full of unequal Parts and Gibboſities, as the Moon is. Wherefore it is as well the more probable as the more common Opinion, that her Light proceeds from both theſe Cauſes, from Reflexion and Illumination; nor doth it herein differ from our Earth, ſince that alſo hath ſome Light by Illumination: For how otherwiſe

wiſe would the Parts about us in a Sun-ſhine Day appear ſo bright, when as the Rays of Reflexion cannot enter into our Eye?

For the better illuſtration of this, we may conſider the ſeveral ways whereby divers Bodies are enlightned. Either as Water by admitting the Beams into its Subſtance; or as Air and Thin Clouds, by tranſmitting the Rays quite thorough their Bodies; or as thoſe things that are of an opacous Nature, and ſmooth Superficies, which reflect the Light only in one place; or elſe as thoſe things which are of an opacous Nature, and rugged Superficies, which by a kind of circumfluous Reflection, are at the ſame time diſcernible in many Places, as our Earth and the Moon.

2. It is compact, and not a ſpungy and porous Subſtance. But this is denied by * *Diogenes*, † *Vitellio*, and ∴ *Reinoldus*, and ſome others, who held the Moon to be of the ſame kind of Nature as a Pumice-ſtone; and this, ſay they, is the Reaſon why in the Sun's Eclipſes, there appears within her a Duskiſh Ruddy Colour, becauſe the Sun-Beams being refracted in paſſing through the Pores of her Body, muſt neceſſarily be repreſented under ſuch a Colour. 2.

* *Plut. de pla. Phil. l. 2. c. 13.*
† *Opt. l. 4.*
∴ *Com. Purbac. Theo. p. 164.*

But I reply, if this be the cauſe of her Redneſs, then why doth ſhe not appear under the ſame Form when ſhe is about a Sextile Aſpect, and the darkned part of her Body is diſcernible? for then alſo do the ſame Rays paſs through her, and therefore in all likelihood ſhould produce the ſame Effect; and notwithſtanding thoſe Beams are then diverted from us, that they cannot enter into our Eyes by a ſtraight Line, yet muſt the Colour ſtill remain viſible in her Body. And beſides, according to this Opinion, the Spots would not always be the ſame, but diverſe as the various diſtance of the Sun requires. Again, if the Sun-beams did paſs through her, why then hath ſhe not

Soaliger Exercit. 80. Sect. 13.

not a Tail (ſaith *Scaliger*) as the Comets? Why doth ſhe appear in ſuch an exact Round? and not rather attended with a long Flame, ſince it is meerly this Penetration of the Sun-beams that is uſually attributed to be the cauſe of Beards in Blazing Stars.

3. *Plut. de facie Lunæ.*

3. It is opacous, not tranſparent or diaphanous like Chryſtal or Glaſs, as *Empedocles* thought, who held the Moon to be a Globe of pure congealed Air, like Hail encloſed in a Sphere of Fire; for then,

1. Why does ſhe not always appear in the Full? ſince the Light is diſperſed through all her Body?

Thucid. Livii. Plut. de facie Lunæ.

2. How can the Interpoſition of her Body ſo darken the Sun, or cauſe ſuch great Eclipſes as have turned Day into Night; that have diſcover'd the Stars, and frighted the Birds with ſuch a ſudden Darkneſs, that they fell down upon the Earth? as it is related in divers Hiſtories. And therefore *Herodotus* telling of an Eclipſe which fell in *Xerxes*'s Time, deſcribes it thus: ὁ ἥλιος ἐκλιπὼν τὴν ἐν τῷ οὐρανῷ ἕδρην ἀφανὴς ἦν. The Sun leaving his wonted Seat in the Heavens, vaniſh'd away: All which argues ſuch a great Darkneſs as could not have been, if her Body had been perſpicuous. Yet ſome there are who interpret all theſe Relations to be Hyperbolical Expreſſions; and the noble *Tycho* thinks it naturally impoſſible that any Eclipſe ſhould cauſe ſuch Darkneſs, becauſe the Body of the Moon can never totally cover the Sun. However, in this he is ſingular, all other Aſtronomers (if I may believe *Keplar*) being on the contrary Opinion, by reaſon the Diameter of the Moon does for the moſt part appear bigger to us than the Diameter of the Sun.

Herodot. l. 7. c. 37.

But here *Julius Cæſar* once more puts in to hinder our Paſſage. The Moon (ſaith he) is not altogether opacous, becauſe 'tis ſtill of the ſame Nature with

De phænom. Lunæ. c. 11.

the

the Heavens, which are incapable of total Opacity: And his Reaſon is, becauſe Perſpicuity is an inſeparable Accident of thoſe purer Bodies; and this he thinks muſt neceſſarily be granted; for he ſtops there, and proves no further; but to this I ſhall defer an Anſwer till he hath made up his Argument.

We may frequently ſee, that her Body does ſo eclipſe the Sun, as our Earth doth the Moon. And beſides, the Mountains that are obſerved there, do caſt a dark Shadow behind them, as ſhall be ſhewed afterwards. Since then the like Interpoſition of them both, doth produce the like Effect, they muſt neceſſarily be of the like Natures, that is, alike opacous, which is the thing to be ſhewed; and this was the Reaſon (as the Interpreters gueſs) why *Ariſtotle* affirmed the Moon to be of the Earth's Nature, becauſe of their Agreement in Opacity; whereas all the other Elements, ſave that, are in ſome meaſure Perſpicuous. Prop. 9. *In. l. de animalib.*

But the greateſt Difference which may ſeem to make our Earth altogether unlike the Moon, is, becauſe the one is a bright Body, and hath Light of its own, and the other a groſs dark Body which cannot ſhine at all. 'Tis requiſite therefore that in the next Place I clear this doubt, and ſhew that the Moon hath no more Light of her own than our Earth.

PROP. V.

That the Moon hath not any Light of her own.

'TWas the Fancy of ſome of the *Jews*, and more eſpecially of *Rabbi Simeon*, that the Moon was nothing elſe but a contracted Sun; and that both thoſe Planets at their firſt Creation, were equal both in Light and Quantity. For, becauſe God did then *Toſtatus in* 1 *Gen. Hyeron. de Sancta fide Hebræomaſt. l.* 2. *c.* 4.

then call them both great Lights, therefore they inferred that they must be both equal in Bigness. But a while after (as the Tradition goes) the ambitious Moon put up her Complaint to God against the Sun, shewing that it was not fit there should be Two such great Lights in the Heavens; a Monarchy would best become the Place of Order and Harmony. Upon this, God commanded her to contract her self into a narrower Compass; but she being much discontented hereat, replies, What! because I have spoken that which is Reason and Equity, must I therefore be diminished? This Sentence could not chuse but much trouble her; and for this reason was she in great Distress and Grief for a long Space; but that her Sorrow might be some way pacified, God bid her be of good Cheer, because her Privileges and Charter should be greater than the Sun's; he should appear in the day time only, she both in the Day and Night; but her Melancholy being not satisfied with this, she replied again, That that alas was no Benefit; for in the day time she should be either not seen, or not noted. Wherefore, God to comfort her up, promised, that his People the *Israelites* should celebrate all their Feasts and Holidays by a Computation of her Months; but this being not able to content her, she has looked very melancholy ever since; however, she hath still reserved much Light of her own.

Others there were, that did think the Moon to be a round Globe; the one half of whose Body was of a Bright Substance, the other half being dark; and the divers Conversions of those sides towards our Eyes, caused the Variety of her Appearances. Of this Opinion was *Berosus*, as he is cited by * *Vitruvius*; and † St. *Austin* thought it was probable enough. But this Fancy is almost equally absurd with the former, and both of them sound rather like Fables, than

* *Lib. 9. Architect.*
† *Narrat. Psalm. item ep. 119.*

than Philoſophical Truths. You may commonly ſee how this latter does contradict frequent and eaſie Experience; for 'tis obſerved, that that Spot which is perceived about her middle when ſhe is in the Increaſe, may be diſcern'd in the ſame Place when ſhe is in the Full: Whence it muſt follow, that the ſame part which was before darkned, is after enlightened, and that the one part is not always dark, and the other light of it ſelf. But enough of this; I would be loth to make an Enemy, that I may afterwards overcome him, or beſtow time in proving that which is already granted; I ſuppoſe now, that neither of them hath any Patrons, and therefore need no Confutation.

'Tis agreed upon by all ſides, that this Planet receives moſt of her Light from the Sun; but the chief Controverſy is, whether or no ſhe hath any of her own? The greater Multitude affirm this. *Cardan* amongſt the reſt, is very confident of it; and he thinks that if any of us were in the Moon at the time of her greateſt Eclipſe, *Lunam aſpiceremus non ſecus ac innumeris cereis ſplendidiſſimis accenſis, atque in eas oculis defixis cæcutiremus*; "We ſhould perceive ſo "great a Brightneſs of her own, that would blind "us with the meer Sight, and when ſhe is enlighten-"ed by the Sun, then no Eagles Eye (if there were "any there) is able to look upon her." This *Cardan* ſays, and he doth but ſay it, without bringing any Proof for its Confirmation. However, I will ſet down the Arguments that are uſually urged for this Opinion, and they are taken either from Scripture or Reaſon; from Scripture is urged that Place, 1 *Cor.* 15. where it is ſaid, *There is one glory of the Sun, and another glory of the Moon.* *Ulyſſes Albergettus* urges that in *Matth.* 24. 29. ἡ σελήνη οὐ δώσει τὸ φέγγος αὐτῆς, *The Moon ſhall not give her light*: Therefore (ſays he) ſhe hath ſome of her own.

De Subtil. l. 3.

But

But to theſe we may eaſily anſwer, that the Glory and Light thereſpoken of, may be ſaid to be hers, though it be derived, as you may ſee in many other Inſtances.

The Arguments from Reaſon are taken either,

1. From that Light which is diſcerned in her, when there is a total Eclipſe of her own Body, or of the Sun.

2. From the Light which is diſcerned in the darker Part of her Body, when ſhe is but a little diſtant from the Sun.

1. For when there are any total Eclipſes, there appears in her Body a great Redneſs, and many times Light enough to cauſe a remarkable Shade, as common Experience doth ſufficiently manifeſt: But this cannot come from the Sun, ſince at ſuch times either the Earth or her own Body ſhades her from the Sunbeams; therefore it muſt proceed from her own Light.

2. Two or three Days after the New Moon, we may perceive Light in her whole Body, whereas the Rays of the Sun reflect but upon a ſmall part of that which is viſible; therefore 'tis likely that there is ſome Light of her own.

In anſwering to theſe Objections, I ſhall firſt ſhew, that this Light cannot be her own; and then declare that which is the true Reaſon of it.

That it is not her own, appears,

1. Becauſe then ſhe would always retain it; but ſhe has been ſometimes altogether inviſible, when as notwithſtanding ſome of the fixed Stars of the fourth or fifth Magnitude might eaſily have been diſcerned cloſe by her: As it was in the Year 1620.

Keplar. ep. Aſtron. cop. l. 6. p. 5. Sect. 2,

2. This may appear likewiſe from the Variety of it at divers times; for 'tis commonly obſerved that ſometimes 'tis of a brighter, ſometimes of a darker Appearance; now redder, and at another time of a more

more duskiſh Colour. The Obſervation of this Variety in divers Eclipſes, you may ſee ſet down by *Keplar* and many others. But now this could not be, if that Light were her own, that being conſtantly the ſame, and without any reaſon of ſuch an Alteration: So that thus I may argue. *Opt. Aſtron. c. 7. num. 3.*

If there were any Light proper to the Moon, then would that Planet appear brighteſt when ſhe is eclipſed in her *Perige*, being neareſt to the Earth; and ſo conſequently more obſcure and duskiſh when ſhe is in her *Apoge* or fartheſt from it; the reaſon is, becauſe the nearer any enlightned Body comes to the Sight, by ſo much the more ſtrong are the Species, and the better perceived. This Sequel is granted by ſome of our Adverſaries, and they are the very Words of noble *Tycho*; *Si Luna genuino gauderet lumine, utique cum in umbra terræ eſſet, illud non amitteret, ſed eò evidentius exereret; omne enim lumen in tenebris, plus ſplendet cum alio majore fulgore non præpeditur.* If the Moon had any Light of her own, then would ſhe not loſe it in the Earth's Shadow, but rather ſhine more clearly; ſince every Light appears greater in the dark, when it is not hinder'd by a more perſpicuous Brightneſs. *De nova ſtella. l. 1. c. 10.*

But now the Event falls out clean contrary, (as Obſervation doth manifeſt, and our Oppoſites themſelves do grant) the Moon appearing with a more reddiſh and clear Light when ſhe is eclipſed, being in her *Apoge* or fartheſt Diſtance, and a more blackiſh Iron Colour when ſhe is in her *Perige* or neareſt to us, therefore ſhe hath not any Light of her own. Nor may we think that the Earth's Shadow can cloud the proper Light of the Moon from appearing, or take away any thing from her inherent Brightneſs; for this were to think a Shadow to be a Body, an Opinion altogether misbecoming a Philoſopher, as *Tycho* grants in the fore-cited Place, *Nec umbra terræ corporeum quid eſt, aut denſa aliqua ſub-* Reinold *Comment. in Purb. Theor. p. 164.*

ſubſtantia, ut Lunæ lumen obtenebrare poſſit, atque id viſui noſtro præripere, ſed eſt quædam privatio luminis ſolaris, ob interpoſitum opacum corpus terræ. Nor is the Earth's Shadow any corporeal Thing, or thick Subſtance, that it can cloud the Moon's Brightneſs, or take it away from our Sight; but it is a meer Privation of the Sun's Light by reaſon of the interpoſition of the Earth's Opacous Body.

3. If ſhe had any Light of her own, then that would in it ſelf be either ſuch a ruddy Brightneſs as appears in the Eclipſes, or elſe ſuch a Leaden duskiſh Light, as we ſee in the darker Parts of her Body, when ſhe is a little paſt the Conjunction. (That it muſt be one of theſe, may follow from the oppoſite Arguments;) but it is neither of theſe, therefore ſhe hath none of her own.

1. 'Tis not ſuch a ruddy Light as appears in Eclipſes; for then why can we not ſee the like Redneſs, when we may diſcern the obſcurer Parts of the Moon?

You will ſay, perhaps, That then the Nearneſs of that greater Light takes away that Appearance.

I reply, This cannot be. For then, why does *Mars* ſhine with his wonted Redneſs, when he is near the Moon? Or why cannot her greater Brightneſs make him appear white, as the other Planets? Nor can there be any Reaſon given, why that greater Light ſhould repreſent her Body under a falſe Colour.

2. 'Tis not ſuch a duskiſh Leaden Light, as we ſee in the darker Part of her Body, when ſhe is about a Sextile Aſpect diſtant from the Sun; for then, why does ſhe appear red in the Eclipſes; ſince mere Shade cannot cauſe ſuch a Variety? For 'tis the Nature of Darkneſs, by its Oppoſition, rather to make Things appear of a more white and clear Brightneſs, than they are in themſelves. Or, if it be the Shade, yet thoſe Parts of the Moon are

then

then in the Shade of her Body, and therefore in reaſon ſhould have the like Redneſs. Since, then, neither of theſe Lights are hers; it follows, that ſhe hath none of her own. Nor is this a ſingular Opinion, but it hath had many Learned Patrons: Such was *Macrobius*, who being for this quoted of *Rhodiginus*, he calls him, *Vir reconditiſſimæ Scientiæ*, a Man who knew more than ordinary Philoſophers; thus commending the Opinion in the Credit of the Author. To him aſſents the Venerable *Bede*, upon whom the Gloſs hath this Compariſon: As the Looking-Glaſs repreſents not any Image within it ſelf, unleſs it receive ſome from without; ſo the Moon hath not any Light, but what is beſtowed by the Sun. To theſe agreed * *Albertus Magnus*, † *Scaliger*, || *Mæſlin*, *Keplar*, and more eſpecially ∴ *Mulapertius*; whoſe Words are more pat to the purpoſe than others, and therefore I ſhall ſet them down as you may find them in his Preface to his Treatiſe concerning the *Auſtriaca Sydera*: *Luna, Venus, & Mercurius, terreſtres & humidæ ſunt Subſtantiæ; ideoque de ſuo non lucere, ſicut nec Terra.* The Moon, *Venus*, and *Mercury*, (ſaith he) are of an earthly and moiſt Subſtance; and therefore have no more Light of their own, than the Earth hath. Nay, ſome there are who think, (tho' without ground) that all the other Stars do receive that Light whereby they appear viſible to us, from the Sun. So *Ptolomy*, * *Iſidore Hiſpalenſis*, † *Albertus Magnus*, and || *Bede*: Much more then, muſt the Moon ſhine with a borrowed Light.

But enough of this. I have now ſufficiently ſhewed what at the firſt I promiſed; That this Light is not proper to the Moon. It remains in the next place, that I tell you the true Reaſon of it. And here, I think 'tis probable, that the Light which appears in the Moon at the Eclipſes, is nothing elſe but the ſecond Species of the Sun's Rays, which paſs

Somn. Scip. l. 1. c. 20. Lect. antiq. l. 1. c. 15.

In lib. de nat. rer.

* *De 4. Coævis. Q. 4. Art. 21.*

† *Exercit. 62.*

|| *Epitom. Aſtron l. 4. p. 2.*

∴ *Epit. Aſtron. Cop. l. 6. part 2. ſect. 2.*

* *Origin. l. 3. c. 60.*

† *De Cælo, l. 2.*

|| *De ratione temp. c. 4. Item Plin. l. 2. c. 6. Hugo de Sancto Victore. Annot. in Gen. 6.*

paſs through the Shadow unto her Body: And from a Mixture of this ſecond Light with the Shadow, ariſes that Redneſs which at ſuch times appears unto us. I may call it *Lumen Crepuſculinum*, the *Aurora* of the Moon, or ſuch a kind of bluſhing Light that the Sun cauſes when he is near his Riſing, when he beſtows ſome ſmall Light upon the thicker Vapours. Thus we ſee commonly the Sun being in the Horizon, and the Reflection growing weak, how his Beams make the Waters appear very red.

2 King. 3. 22. 2. *Quæſt. in hoc cap.*

The *Moabites*, in *Jehoram*'s time, when they roſe early in the Morning, and beheld the Waters afar off, miſtook them for Blood. *Et cauſa hujus eſt, quia radius ſolaris in Aurora contrahit quondam rubedinem, propter Vapores combuſtos manentes circa ſuperficiem terræ, per quos radii tranſeunt; & ideo cum repercutiantur in aqua ad oculos noſtros, trahunt ſecum eundem ruborem, & faciunt apparere locum aquarum, in quo eſt repercuſſio, eſſe rubrum*; ſaith *Toſtatus*. The Reaſon is, becauſe of his Rays; which being in the lower Vapours, thoſe do convey an imperfect mixed Light upon the Waters. Thus the Moon being in the Earth's Shadow, and the Sun-beams which are round about it not being able to come directly unto her Body; yet ſome ſecond Rays there are, which paſſing through the Shadow, make her appear in that ruddy Colour: So that ſhe muſt appear brighteſt, when ſhe is eclipſed, being in her *Apoge* or greateſt Diſtance from us; becauſe then the Cone of the Earth's Shadow is leſs, and the Refraction is made through a narrower Medium. So on the contrary, ſhe muſt be repreſented under a more dark and obſcure Form when ſhe is eclipſed, being in her *Perige*, or neareſt to the Earth; becauſe then ſhe is involved in a greater Shadow, or bigger part of the Cone; and ſo the Refraction paſſing through a greater Medium, the Light muſt needs

be

be weaker which doth proceed from it. If you ask now, What the Reaſon may be of that Light which we diſcern in the darker Part of the New Moon? I anſwer; 'Tis reflected from our Earth; which returns as great a Brightneſs to that Planet, as it receives from it. This I ſhall have occaſion to prove afterward.

I have now done with theſe Propoſitions, which were ſet down to clear the Paſſage, and confirm the Suppoſitions implied in the Opinion. I ſhall in the next place proceed to a more direct Treating of the chief Matter in hand.

PROP. VI.

That there is a World in the Moon, hath been the direct Opinion of many Ancient, with ſome Modern Mathematicians; and may probably be deduced from the Tenents of others.

SInce this Opinion may be ſuſpected of Singularity, I ſhall therefore firſt confirm it by ſufficient Authority of divers Authors, both ancient and modern; that ſo I may the better clear it from the Prejudice either of an upſtart Fancy, or an obſolete Error. This is by ſome attributed to *Orpheus*, one of the moſt ancient *Greek* Poets. Who ſpeaking of the Moon, ſays thus; ἡ πολλ' ἔρεα ἔχει, πολλ' ἄστεα, πολλα μέλαθρα, That it hath many Mountains, and Cities, and Houſes in it. To him aſſented *Anaxagoras*, *Democritus*, and *Heraclides*; all who thought it to have firm ſolid Ground, like to our Earth; containing in it many large Fields, Champion Grounds, and divers Inhabitants.

Plut. de plac. phil. l. 2. c. 13.

Ibid. c. 25.

Diog. Laert. l. 2. & l. 9.

Of this Opinion likewiſe was *Xenophanes*, as he is cited for it by *Lactantius*; tho' that Father (perhaps)

Div. Inſt. l. 3. c. 23.

haps) did miſtake his Meaning, whilſt he relates it thus: *Dixit Xenophanes, intra concavum Lunæ eſſe aliam terram, & ibi aliud genus hominum, ſimili modo vivere ſicut nos in hac terra,* &c. As if he had conceived the Moon to be a great hollow Body, in the midſt of whoſe Concavity, there ſhould be another Globe of Sea and Land, inhabited by Men, as our Earth is: Whereas, it ſeems to be more likely by the Relation of others, that this Philoſopher's Opinion is to be underſtood in the ſame Senſe as it is here to be proved. True indeed, the Father condemns this Aſſertion, as an equal Abſurdity to that of *Anaxagoras*, who affirmed the Snow to be black: But no wonder; for in the very next Chapter it is, that he does ſo much deride the Opinion of thoſe who thought there were *Antipodes*. So that his Ignorance in that particular, may perhaps diſable him from being a competent Judge in any other the like Point of Philoſophy. Unto theſe agreed *Pythagoras*, who thought that our Earth was but one of the Planets which moved round about the Sun, (as *Ariſtotle* relates it of him;) and the *Pythagoreans* in general did affirm that the Moon alſo was Terreſtrial, and that ſhe was inhabited as this lower World: That thoſe living Creatures and Plants which are in her, exceed any of the like kind with us in the ſame Proportion, as their Days are longer than ours: *Viz.* by Fifteen Times. This *Pythagoras* was eſteemed by all, of a moſt Divine Wit, as appears eſpecially by his Valuation amongſt the *Romans*; who being commanded by the Oracle to erect a Statue to the Wiſeſt *Grecian*, the Senate determined *Pythagoras* to be meant; preferring him in their Judgments before the Divine *Socrates*, whom their Gods pronounc'd the Wiſeſt. Some think him a *Jew* by Birth; but moſt agree that he was much converſant amongſt the learneder Sort and Prieſts of that Nation, by whom he was informed of many.

De Cœlo, l. 2. c. 13.

Plut. ibid. cap. 30.

Plin. Nat. Hiſt. l. 34. cap. 6.

ny Secrets; and (perhaps) this Opinion which he vented afterwards in *Greece*, where he was much opposed by *Aristotle* in some worded Disputations, but never confuted by any solid Reason.

To this Opinion of *Pythagoras* did *Plato* also assent, when he considered that there was the like Eclipse made by the Earth; and this, that it had no Light of its own, that it was so full of Spots. And therefore we may often read in him and his Followers, of an *ætherea terra*, and *lunares populi*, an Æthereal Earth, and Inhabiters in the Moon; but afterwards this was mixed with many ridiculous Fancies: For some of them considering the Mysteries implied in the Number Three, concluded that there must necessarily be a Trinity of Worlds, whereof the first is this of ours; the second in the Moon, whose Element of Water is represented by the Sphere of *Mercury*, the Air by *Venus*, and the Fire by the Sun. And that the whole Universe might the better end in Earth as it began; they have contrived it, that *Mars* shall be a Sphere of the Fire, *Jupiter* of Air, *Saturn* of Water; and above all these, the *Elysian* Fields, spacious and pleasant Places appointed for the Habitation of those unspotted Souls, that either never were imprisoned in, or else now have freed themselves from any Commerce with the Body. *Scaliger* speaking of this *Platonick* Fancy, *quæ in tres trientes mundum quasi assem divisit*, thinks 'tis Confutation enough, to say, 'tis *Plato*'s. However, for the first part of this Assertion, it was assented unto by many others, and by reason of the Grosness and Inequality of this Planet, 'twas frequently called *quasi terra cœlestis*, as being esteemed the Sediment and more imperfect Part of those purer Bodies; you may see this proved by *Plutarch*, in that delightful Work which he properly made for the Confirmation of this particular. With him agreed *Alcinous* and *Plotinus*, later Writers.

Plat. de conviviis. Macrob. Somn Scip. l. 1. c. 11.

Exerc. 62.

De facie Lunæ.

Instit. ad discip. plat. Cæl. Rhodig. l. 1. c. 4.

Thus *Lucian* alſo in his Diſcourſe of a Journey to the Moon, where though he does ſpeak many things out of Mirth and in a jeſting Manner; yet in the Beginning of it he does intimate that it did contain ſome ſerious Truths concerning the real Frame of the Univerſe.

Cuſa. de doct. ign. l. 2. cap. 12.

The Cardinal *Cuſanus* and *Fornandus Brunus*, held a particular World in every Star; and therefore one of them defining our Earth, he ſays, it is *ſtella quædam nobilis, quæ lunam & calorem & influentiam habet aliam, & diverſam ab omnibus aliis ſtellis*; "a noble "Star, having a diſtinct Light, Heat, and Influence "from all the reſt. Unto this *Nicholas Hill*, a Countryman of ours, was inclined, when he ſaid *Aſtrea terræ natura probabilis eſt*: "That 'tis probable the "Earth hath a ſtarry Nature.

Philoſ. Epicur. par. 434.

But the Opinion which I have here delivered, was more directly proved by * *Mæſlin*, † *Keplar*, and ∴ *Galilæus*; each of them late Writers, and famous Men for their ſingular Skill in Aſtronomy. *Keplar* calls this World by the Name of *Levania*, from the *Hebrew* Word לבנה which ſignifies the Moon, and our Earth by the Name of *Volva, a volvendo*; becauſe it does by reaſon of its diurnal Revolution appear unto them conſtantly to turn round; and therefore he ſtiles thoſe who live in that Hemiſphere which is towards us, by the Title of *Subvolvani*, becauſe they enjoy the Sight of this Earth; and the others *Privolvani*, *quia ſunt privati conſpectu volvæ*, becauſe they are deprived of this Priviledge. But *Julius Cæſar*, whom I have above quoted, ſpeaking of their Teſtimony whom I cite for this Opinion, *viz.* *Keplar* and *Galilæus*, affirms that to his Knowledge they did but jeſt in thoſe things which they write concerning this; and as for any ſuch World, he aſſuredly knows they never ſo much as dreamt of it. But I had rather believe their own words, than his pretended Knowledge.

* *In Theſibus.*

† *Diſſertatio cum Nunc.*

∴ *Nuncius Sydereus. Somn. Aſtr.*

Dephænom. Lunæ. c. 4.

'Tis

'Tis true indeed, in ſome things they do but trifle, but for the main Scope of thoſe Diſcourſes, 'tis as manifeſt they ſeriouſly meant it, as any indifferent Reader may eaſily diſcern: As for *Galilæus*, 'tis evident that he did ſet down his own Judgment and Opinion in theſe Things; otherwiſe ſure *Campanella* (a Man as well acquainted with his Opinion, and perhaps his Perſon, as *Cæſar* was) would never have writ an Apology for him. And beſides, 'tis very likely if it had been but a Jeſt, *Galilæus* would never have ſuffered ſo much for it, as Report ſaith afterwards he did.

And as for *Keplar*, I will only refer the Reader to his own Words, as they are ſet down in the Preface to the Fourth Book of his *Epitom*; where his Purpoſe is to make an Apology for the Strangeneſs of thoſe Truths that he was there to deliver, amongſt which there are divers things to this Purpoſe concerning the Nature of the Moon. He profeſſes that he did not publiſh them either out of a Humour of Contradiction, or a Deſire of Vain-glory, or in a jeſting Way to make himſelf or others merry, but after a conſiderate and ſolemn Manner for the Diſcovery of the Truth.

Now as for the Knowledge which *Cæſar* pretends to the contrary, you may gueſs what it was by his ſtrange Confidence in other Aſſertions, and his Boldneſs in them may well derogate from his Credit in this. For ſpeaking of *Ptolemy*'s *Hypotheſis*, he pronounces this Verdict, *Impoſſibile eſt excentricorum & epicyclorum poſitio, nec aliquis eſt ex Mathematicis adeo ſtultus qui veram illam exiſtimet.* "The Poſition of "*Excentricks* and *Epicycles* is altogether impoſſible, nor "is there any Mathematician ſuch a Fool as to think "it true." I ſhould gueſs he could not have Knowledge enough to maintain any other *Hypotheſis*, who was ſo ignorant in Mathematicks as to deny that any good Author held this. For I would fain know *Cap.* 7.

whether there were never any that thought the Heavens to be ſolid Bodies, and that there were ſuch kinds of Motion as is by thoſe fained Orbs ſupplied; if ſo, *Cæſar la Galla* was much miſtaken. I think his Aſſertions are equally true, that *Galilæus* and *Keplar* did not hold this; and that there were none which ever held that other. Thus much for the Teſtimony of thoſe who were directly of this Opinion.

But, in my following Diſcourſe, I ſhall moſt inſiſt on the Obſervation of *Galilæus*, the Inventor of that famous Perſpective, whereby we may diſcern the Heavens hard by us; whereby thoſe things which others have formerly gueſs'd at, are manifeſted to the Eye, and plainly diſcovered beyond Exception or Doubt; of which admirable Invention, theſe latter Ages of the World may juſtly boaſt, and for this expect to be celebrated by Poſterity. 'Tis related of *Eudoxus*, that he wiſhed himſelf burnt with *Phaeton*, ſo he might ſtand over the Sun to contemplate its Nature; had he lived in theſe Days, he might have enjoyed his Wiſh at an eaſier Rate; and ſcaling the Heavens by this Glaſs, might plainly have diſcerned what he ſo much deſired. *Keplar* conſidering thoſe ſtrange Diſcoveries which this Perſpective had made, could not chuſe but cry out in a περιποιησις and Rapture of Admiration, O *multiſcium & quovis ſceptro pretioſius perſpicillum! an qui te dextrâ tenet, ille non dominus conſtituatur operum Dei?* And *Johannes Fabricius*, an elegant Writer, ſpeaking of the ſame Glaſs, and for this Invention preferring our Age before thoſe former times of greater Ignorance, ſays thus: *Adeo ſumus ſuperiores veteribus, ut quam illi carminis magici pronunciatu demiſſam repreſentaſſe putantur, nos non tantum innocenter demittamus, ſed etiam familiari quodam intuitu ejus quaſi conditionem intueamur.* "So much are we above the Anci-
"ents, that whereas they were fain by their Magical
"Charms to repreſent the Moon's Approach, we can-

De macula in ſol obſer.

" cannot only bring her lower with a greater Inno-
" cence, but may alſo with a more familiar View
" behold her Condition." And becauſe you ſhall have no occaſion to queſtion the truth of thoſe Experiments which I ſhall afterwards urge from it, I will therefore ſet down the Teſtimony of an Enemy; and ſuch a Witneſs hath always been accounted prevalent: You may ſee it in the above-named *Cæſar la Galla*, whoſe Words are theſe. *Mercurium caduceum geſtantem, cæleſtia nunciare, & mortuorum animas ab inferis revocare ſapiens finxit antiquitas. Galilæum vero novum Jovis interpretem Teleſcopio caduceo inſtructum Sydera aperire, & veterum Philoſophorum manes ad ſuperos revocare ſolers noſtra ætas videt & admiratur.* " Wiſe An-
" tiquity fabled *Mercury* carrying a Rod in his hand
" to relate News from Heaven, and call back the
" Souls of the Dead; but it hath been the Happineſs
" of our induſtrious Age, to ſee and admire *Galilæus*,
" (the new Ambaſſador of the Gods) furniſhed with
" his Perſpective to unfold the Nature of the Stars,
" and awaken the Ghoſts of the ancient Philoſo-
" phers." So worthily and highly did theſe Men eſteem of this excellent Invention. *De phænom. cap. 1.*

Now if you would know what might be done by this Glaſs, in the ſight of ſuch things as were nearer at hand, the ſame Author will tell you, when he ſays, That by it thoſe things which could ſcarce at all be diſcerned by the Eye, at the diſtance of a Mile and a half, might plainly and diſtinctly be perceived for 16 *Italian* Miles, and that as they were really in themſelves, without any Tranſpoſition or Falſifying at all. So that what the ancient Poets were fain to put in a Fable, our more happy Age hath found out in a Truth; and we may diſcern as far with theſe Eyes which *Galilæus* hath beſtowed upon us, as *Lynceus* could with thoſe which the Poets attributed unto him. But if you yet doubt whether all theſe Obſervations were true, the ſame Author may confirm you, when he *Ibid. c. 6.*

Cap. 1. ſays they were ſhewed, *Non uni aut alteri, ſed quamplurimis, neq; gregariis hominibus, ſed præcipuis atq; diſciplinis omnibus, necnon Mathematicis & Opticis præceptis optime in ſtructis ſedulò ac diligenti inſpectione.* "Not to one "or two, but to very many, and thoſe not ordinary "Men, but to thoſe who were well vers'd in Mathe- "maticks and Opticks; and that not with a meer "Glance, but with a ſedulous and diligent Inſpecti- "on." And leſt any Scruple might remain unanſwered, or you might think the Men who beheld all this, though they might be skilful, yet they came with credulous Minds, and ſo were more eaſie to be deluded: He adds that it was ſhewed, *Viris qui ad experimenta hæc contradicendi animo acceſſerant.* "To ſuch Cap. 5. "as were come with a great deal of Prejudice, and "an intent of Contradiction." Thus you may ſee the Certainty of thoſe Experiments which were taken by this Glaſs. I have ſpoken the more concerning it, becauſe I ſhall borrow many things in my further Diſcourſe, from thoſe Diſcoveries which were made by it.

I have now cited ſuch Authors both Ancient and Modern, who have directly maintained the ſame Opinion. I told you likewiſe in the Propoſition, that it might probably be deduced from the Tenents of o- thers: Such were *Ariſtarchus*, *Philolaus*, and *Copernicus*, with many other later Writers, who aſſented to their Hypotheſis; ſo *Joach. Rhelicus*, *David Origanus Lanſbergius*, *Guil. Gilbert*; and, (if I may believe *Campanella*) *Innumeri alii Angli & Galli*; Very many o- thers, both *Engliſh* and *French*, all who affirmed our Earth to be one of the Planets, and the Sun to be the Center of all, about which the Heavenly Bodies did move. And how horrid ſoever this may ſeem at the firſt, yet is it likely enough to be true, nor is there any Maxim or Obſervation in *Opticks* (ſaith *Pena*) that can diſprove it.

See the Second Book. 1. Prop.

Apologia pro Galilæo.

Now

Now if our Earth were one of the Planets (as it is according to them) then why may not another of the Planets be an Earth?

Thus have I ſhewed you the Truth of this Propoſition. Before I proceed farther, 'tis requiſite that I inform the Reader what Method I ſhall follow in the proving of this chief Aſſertion, *That there is a World in the Moon.*

The Order by which I ſhall be guided, will be that which *Ariſtotle* uſes in his Book *De Mundo* (if that Book were his.)

Firſt, περὶ τῶν ἐν αὐτῇ, of thoſe chief Parts which are in it; not the Elementary and Æthereal (as he doth there) ſince this does not belong to the preſent Queſtion, but of the Sea and Land, *&c.* Secondly, περὶ αὐτῆς παθῶν, of thoſe things which are Extrinſical to it, as the Seaſons, Meteors, and Inhabitants.

PROP. VII.

That thoſe Spots and brighter Parts, which by our Sight may be diſtinguiſhed in the Moon, do ſhew the Difference betwixt the Sea and Land in that other World.

FOR the clear Proof of this Propoſition, I ſhall firſt reckon up and refute the Opinions of others concerning the Matter and Form of thoſe Spots, and then ſhew the greater Probability of this preſent Aſſertion, and how agreeable it is to that Truth which is moſt commonly received. As for the Opinions of others concerning theſe, they have been very many: I will only reckon up thoſe which are common and remarkable.

Some there are that think thoſe Spots do not ariſe from any Deformity of the Parts, but a Deceit of the Eye,

Eye, which cannot at ſuch a Diſtance diſcern an equal Light in that Planet: But theſe do but only ſay it, and ſhew not any Reaſon for the Proof of their Opinion. Others think that there are ſome Bodies betwixt the Sun and Moon, which keeping off the Light in ſome Parts, do by their Shadow produce theſe Spots which we there diſcern.

So *Bede* in *l. de Mund. conſtit.*

Others would have them to be the Figure of the Seas or Mountains here below, repreſented there as in a Looking-Glaſs. But none of thoſe Fancies can be true, becauſe the Spots are ſtill the ſame, and not varied according to the difference of Places; and beſides, *Cardan* thinks it is impoſſible that any Image ſhould be conveyed ſo far, as there to be repreſented unto us at ſuch a diſtance. But 'tis commonly related of *Pythagoras*, that he by writing what he pleaſed in a Glaſs, by the Reflexion of the ſame Species would make thoſe Letters to appear in the Circle of the Moon, where they ſhould be legible by any other, who might at that time be ſome Miles diſtant from him. * *Agrippa* affirms this to be poſſible, and the way of performing it not unknown to himſelf, with ſome others in his time. It may be, that Biſhop *Godwin* did by the like Means perform thoſe ſtrange Concluſions, which he profeſſes in his *Nuncius Inanimatus*; where he pretends, that he can inform his Friends of what he pleaſes, though they be an hundred Miles diſtant, *forte etiam, vel milliare milleſimum*, (they are his own Words) and perhaps a thouſand; and all this in a little ſpace, quicker than the Sun can move.

De ſubtil. lib. 3.

* *Occulta Philoſ. l.* 1. *cap.* 6.

Now, what Conveyance there ſhould be for ſo ſpeedy a Paſſage, I cannot conceive, unleſs it be carried with the Light, than which we know not any thing quicker. But of this only by the way. However, whether thoſe Images can be repreſented ſo or not, yet certain it is, thoſe Spots are not ſuch Repreſentations. Some think that when God had at firſt created too much Earth to make a perfect Globe, not know-

knowing well where to beſtow the reſt, he placed it in the Moon, which ever ſince hath ſo darkned it in ſome Parts: But the Impiety of this is ſufficient Confutation, ſince it ſo much detracts from the Divine Power and Wiſdom.

The * Stoicks held that Planet to be mixed of Fire and Air; and in their Opinion, the Variety of its Compoſition cauſed her Spots: Being not aſhamed to ſtile the ſame Body a Goddeſs, calling it *Diana*, *Minerva*, &c. and yet affirm it to be an impure Mixture of Flame and Smoak, and fuliginous Air.——But this Planet cannot conſiſt of Fire, ſaith *Plutarch*, becauſe there is not any Fewel to maintain it. And the Poets have therefore fained *Vulcan* to be Lame, becauſe he can no more ſubſiſt without Wood or other Fewel, than a Lame Man without a Staff.

* *Plut. de placit. phil. l. 2. c. 25.*

Anaxagoras thought all the Stars to be of an Earthly Nature, mixed with ſome Fire; and as for the Sun, he affirmed it to be nothing elſe but a fiery Stone: For which latter Opinion, the *Athenians* ſentenc'd him to Death; thoſe zealous Idolaters counting it a great Blaſphemy to make their God a Stone; whereas notwithſtanding, they were ſo ſenſeleſs in their Adoration of Idols, as to make a Stone their God. This *Anaxagoras* affirmed the Moon to be more Terreſtrial than the other Planets, but of a greater Purity than any thing here below; and the Spots he thought were nothing elſe but ſome Cloudy Parts intermingled with the Light which belonged to that Planet; but I have above deſtroyed the Suppoſition on which this Fancy is grounded. *Pliny* thinks they ariſe from ſome Droſſy Stuff, mixed with that Moiſture which the Moon attracts unto her ſelf; but he was of their Opinion who thought the Stars were nouriſhed by ſome Earthly Vapours; which you may commonly ſee refuted in the *Commentators* on the Books *de Cælo*.

Joſephus l. 2. con. App. Auguſt. de Civit. Dei. l. 18. c. 41.

Nat. Hiſt. l. 2. c. 9.

Fitello

Vitellio and *Reinoldus* affirm the Spots to be the thicker Parts of the Moon, into which the Sun cannot infuse much Light; and this (say they) is the Reason why in the Sun's Eclipses the Spots and brighter Parts are still in some measure distinguished, because the Sun-Beams are not able so well to penetrate through those thicker, as they may through the thinner Parts of that Planet. Of this Opinion also was *Cæsar la Galla*, whose Words are these; "The Moon doth "there appear cleareſt, where she is transpicuous, not "only through the Superficies, but the Substance al- "so; and there she seems spotted, where her Body is "most opacous." The Ground of this his Assertion was, because he thought the Moon did receive and bestow her Light by Illumination only, and not at all by Reflexion; but this, together with the supposed penetration of the Sun-beams, and the perspicuity of the Moon's Body I have above answered and refuted.

Opt. lib. 9. Comment. in Purb. p. 164.

Ex qua parte luna est transpicua non solum secundum superficiem, sed etiam secundum substantiam, eatenus clara, ex qua autem parte opaca est, eatenus obscura videtur. De Phænom. cap. 11.

The more common and general Opinion is, that the Spots are the thinner parts of the Moon, which are less able to reflect the Beams that they receive from the Sun, and this is most agreeable to Reason; for if the Stars are therefore brighteſt, because they are thicker and more solid than their Orbs, then it will follow, that those Parts of the Moon which have less Light, have also less thickness. It was the Providence of Nature (say some) that so contrived that Planet to have these Spots within it; for since that is neareſt to those Lower Bodies which are so full of Deformity, 'tis requisite that it should in some measure agree with them; and as in this Inferior World, the higher Bodies are the most compleat, so also in the Heavens, Perfection is ascended unto by degrees, and the Moon being the loweſt, must be the least pure; and therefore *Philo* the *Jew* interpreting *Jacob*'s Dream concerning the Ladder, doth in an Allegory shew how that in the Fabrick of the

Albert. mag. de Cœvis. Q. 4. Art. 21. Colleg. Con.

De Somniis.

World,

World, all things grow perfecter as they grow higher ; and this is the Reaſon (ſaith he) why the Moon doth not conſiſt of any pure ſimple Matter, but is mix'd with Air, which ſhews ſo darkly within her Body.

But this cannot be a ſufficient Reaſon ; for tho' it were true that Nature did frame every thing perfecter as it was higher, yet is it as true that Nature frames every thing fully perfect for that Office to which ſhe intends it. Now had ſhe intended the Moon meerly to reflect the Sun-beams, and give Light, the Spots then had not ſo much argued her Providence, as her unskilfulneſs and overſight, as if in the haſt of her Work ſhe could not tell how to make that Body exactly fit for that Office to which ſhe intended it. *Scalig. exercit.* 62.

'Tis likely then that ſhe had ſome other end which moved her to produce this Variety; and this, in all probability, was her intent, to make it a fit Body for habitation, with the ſame Conveniences of Sea and Land, as this Inferior World doth partake of. For ſince the Moon is ſuch a vaſt, ſuch a ſolid and opacous Body, like our Earth (as was above proved) why may it not be probable that thoſe thinner and thicker Parts appearing in her, do ſhew the difference betwixt the Sea and Land in that other World ? And *Galilæus* doubts not, but that if our Earth were viſible at the ſame diſtance, there would be the like appearance of it.

If we conſider the Moon as another habitable Earth, then the Appearances of it will be altogether exact and beautiful, and may argue unto us that it is fully accompliſh'd for all thoſe Ends to which Providence did appoint it. But conſider it barely as a Star or Light, and then there will appear in it much imperfection and deformity, as being of an impure dark Subſtance, and ſo unfit for the Office of that Nature.

As

As for the Form of thoſe Spots, ſome of the Vulgar think they repreſent a Man, and the Poets gueſs 'tis the Boy *Endymion*, whoſe Company ſhe loves ſo well, that ſhe carries him with her: Others will have it only to be the Face of a Man, as the Moon is uſually pictured; but *Albertus* thinks rather, that it repreſents a Lyon with his Tail towards the *Eaſt*, and his Head the *Weſt*; and * ſome others have thought it to be very much like a Fox; and certainly 'tis as much like a Lyon as that in the *Zodiack*, or as *Urſa Major* is like a Bear.

* *Euſebius Nieremb. Hiſt. Nat. l.* 8. *c.* 15.

I ſhould gueſs that it repreſents one of theſe as well as another, and any thing elſe as well as any of theſe, ſince 'tis but a ſtrong Imagination which fancies ſuch Images, as School-Boys uſually do in the Marks of a Wall, whereas there is not any ſuch Similitude in the Spots themſelves, which rather like our Sea, in reſpect of the Land, appears under a rugged and confuſed Figure, and doth not repreſent any diſtinct Image: So that both in reſpect of the Matter and the Form, it may be probable enough that thoſe Spots and brighter Parts may ſhew the diſtinction betwixt the Sea and Land in that other World.

PROP. VIII.

The Spots repreſent the Sea, and the Brighter Parts the Land.

WHEN I firſt compared the Nature of our Earth and Water with thoſe Appearances in the Moon, I concluded contrary to the Propoſition, that the Brighter Parts repreſented the Water, and the Spots the Land. Of this Opinion likewiſe was *Keplar* at the firſt. But my Second Thoughts, and the reading

Opt. Aſtro. c. 6. *num.* 9. *Diſſert. cum nuncio Gal.*

reading of others, have now convinced me (as after he was) of the Truth of thatPropoſition which I have now ſet down. Before I come to the confirmation of it, I ſhall mention thoſe Scruples which at firſt made me doubt the truth of this Opinion.

1. It may be objected, 'tis probable, if there be any ſuch Sea and Land as ours, that it bears ſome proportion and ſimilitude with ours: But now this Propoſition takes away all likeneſs betwixt them. For whereas the Superficies of our Earth is but the third part of the whole Surface in the Globe, two parts being overſpread with the Water (as *Scaliger* obſerves) yet here, according to this Opinion, the Sea ſhould be leſs than the Land, ſince there is not ſo much of the Beſpotted as there is of the Enlightned Parts; wherefore 'tis probable that there is no ſuch Thing at all, or elſe that the Brighter Parts are the Sea. *Exercit.* 38.

2. The Water, by reaſon of the ſmoothneſs of its Superficies, ſeems better able to reflect the Sun-beams than the Earth, which in moſt places is ſo full of ruggedneſs, of Graſs and Trees, and ſuch like Impediments of Reflexion; and beſides, Common Experience ſhews that the Water ſhines with a greater and more glorious Brightneſs than the Earth; therefore it ſhould ſeem that the Spots are the Earth, and the brighter Parts the Water. But to the firſt it may be anſwered.

1. There is no great probability in this Conſequence, that becauſe 'tis ſo with us, therefore it muſt be ſo with the Parts of the Moon; for ſince there is ſuch a difference betwixt them in divers other reſpects, they may not perhaps agree in this.

2. That Aſſertion of *Scaliger* is not by all granted for a Truth. *Fromondus* with others think that the Superficies of the Sea and Land, in ſo much of the World as is already diſcover'd, is equal and of the ſame extenſion. *De Meteoris, l.* 5. *c.* 1. *Art.* 1.

3. The

3. The Orb of Thick and Vaporous Air which encompaſſes the Moon, makes the brighter Parts of that Planet appear bigger than in themſelves they are; as I ſhall ſhew afterwards.

To the Second it may be anſwered, That though the Water be of a ſmooth Superficies, and ſo may ſeem moſt fit to reverberate the Light, yet becauſe 'tis of a perſpicuous Nature, therefore the Beams muſt ſink into it, and cannot ſo ſtrongly and clearly be reflected. *Sicut in ſpeculo ubi plumbum abraſum fuerit*, (ſaith *Cardan*) as in Looking-Glaſſes, where part of the Lead is razed off, and nothing left behind to reverberate the Image, the Species muſt there paſs through, and not back again: So it is where the Beams penetrate and ſink into the ſubſtance of the Body, there cannot be ſuch an immediate and ſtrong Reflexion, as when they are beat back from the Superficies; and therefore the Sun cauſes a greater heat by far upon the Land, than upon the Water. Now as for that Experiment, where it is ſaid, That the Waters have a greater Brightneſs than the Land; I anſwer, 'Tis true only there where they repreſent the Image of the Sun, or ſome bright Cloud, and not in other Places; eſpecially if we look upon them at any great diſtance, as is very plain by common Obſervation.

And 'tis certain, that from any high Mountain the Land does appear a great deal brighter than any Lake or River.

This may yet be farther illuſtrated by the Similitude of a Looking-Glaſs hanging upon a Wall in the Sun ſhine; where, if the Eye be not placed in the juſt Line of Reflexion from the Glaſs, 'tis manifeſt that the Wall will be of a brighter Appearance than the Glaſs. True indeed, in the Line of Reflexion, the Light of the Glaſs is equal almoſt unto that which comes immediately from the Sun it ſelf; but now this is only in one particular Place, and ſo is not like

that

that Brightneſs which we diſcern in the Moon; becauſe this does appear equally in ſeveral Situations, like that of the Wall, which does ſeem bright as well from every Place, as from any one. And therefore the roughneſs of the Wall, or (as it is in the Objection) the ruggedneſs of our Earth, is ſo far from being an hindrance of ſuch a Reflexion as there is from the Moon, that it is rather required as a neceſſary Condition unto it. We may conceive that in every rough Body, there are, as it were, innumerable Superficies, diſpoſed unto an innumerable Diverſity of Inclinations. *Ita ut nullus ſit locus, ad quem non pertingant plurimi radii reflexi a plurimis ſuperficiecculis, per omnem corporis ſcabri radiis luminoſis percuſſi ſuperficiem diſperſis.* " So " that there is not any Place unto which there are " not ſome Beams reflected from theſe diverſe Super- " ficies, in the ſeveral Parts of ſuch a rugged Body." But yet (as I ſaid before) the Earth does receive a great part of its Light by Illumination, as well as by Reflexion.

Galilæus Syſtem. Coll. 1.

So that notwithſtanding thoſe Doubts, yet this Propoſition may remain true, That the Spots may be the Sea, and the brighter Parts the Land. Of this Opinion was *Plutarch*: Unto him aſſented *Keplar* and *Galilæus*, whoſe Words are theſe: *Si quis veterum Pythagoreorum ſententiam exuſcitare velit, lunam ſcilicet eſſe quaſi tellurem alteram ejus pars lucidior terrenam ſuperficiem, obſcurior vero aqueam magis congruè repræſentet. Mihi autem dubium fuit nunquam terreſtris globi à longe conſpecti, atque a radiis ſolaribus perfuſi, terream ſuperficiem clariorem, obſcuriorem vero aqueam ſeſe in conſpectum daturam.* " If any Man have a mind to renew the Opinion of " the *Pythagoreans*, That the Moon is another Earth; " then her brighter Parts may fitly repreſent the " Earth's Superficies, and the darker part the Water: " And for my part, I never doubted but that our " Earthly Globe being ſhined upon by the Sun, " and beheld at a great diſtance, the Land would

De facie Lun. Diſſertatio Nunc. Syd.

" appear brighteſt, and the Sea more obſcurely." The Reaſons may be,

1. That which I urged about the foregoing Chapter; becauſe the Water is the thinner part, and therefore muſt give leſs Light.

Since the Stars and Planets, by reaſon of their Brightneſs, are uſually concluded to be the thicker Parts of their Orb.

In lib. de coloribs.

2. Water is in it ſelf of a blacker Colour (ſaith *Ariſtotle*) and therefore more remote from Light than the Earth. Any Part of the Ground being moiſtned with Rain, does look much more darkly than when it is dry?

3. 'Tis obſerved that the Secondary Light of the Moon (which afterwards is proved to proceed from our Earth) is ſenſibly brighter unto us, for two or three Days before the Conjunction, in the Morning when ſhe appears Eaſtward, than about the ſame time after the Conjunction, when ſhe is ſeen in the *Weſt*. The Reaſon of which muſt be this, becauſe that part of the Earth which is oppoſite to the Moon in the *Eaſt*, has more Land in it than Sea. Whereas on the contrary, the Moon when ſhe is in the *Weſt*, is ſhined upon by that part of our Earth where there is more Sea than Land; from whence it will follow with good probability, that the Earth does caſt a greater Light than the Water.

4. Becauſe Obſervation tells us, that the Spotted Parts are always ſmooth and equal, having every where an equality of Light when once they are enlightned by the Sun; whereas the brighter parts are full of rugged Gibboſities and Mountains, having many Shades in them, as I ſhall ſhew more at large afterwards.

That in this Planet there muſt be Seas, *Campanella* endeavours to prove out of Scripture, interpreting *the Waters above the Firmament*, ſpoken in *Geneſis*, to be meant of the Sea in this World. For (ſaith he) 'tis

Apologia pro Galileo.

not

not likely that there are any ſuch Waters above the Orbs to moderate that Heat which they receive from their ſwift Motion (as ſome of the Fathers think). Nor did *Moſes* mean the Angels, which may be call'd Spiritual Waters, as *Origen* and *Auſtin* would have it, for both theſe are rejected by the General Conſent: Nor could he mean any Waters in the Second Region, as moſt Commentators interpret it. For firſt there is nothing but Vapours, which though they are afterwards turned into Water, yet while they remain there, they are only the Matter of that Element, which may as well be Fire, or Earth, or Air. 2. Thoſe Vapours are not above the Expanſum, but in it. So that he thinks there is no other way to ſalve all, but by making the Planets ſeveral Worlds with Sea and Land, with ſuch Rivers and Springs as we have here below: Eſpecially ſince *Eſdras* ſpeaks of the Springs above the Firmament. But I cannot agree with him in this, nor do I think that any ſuch thing can be proved out of Scripture.

Vide Ieron. Epiſt. ad Pammachium. Confeſſion. l.13. c.32. Retracted lib.2. Retr. cap.6.

2 Eſdr. 4. 7.

Before I proceed to the next Poſition, I ſhall firſt anſwer ſome Doubts which might be made againſt the generality of this Truth, whereby it may ſeem impoſſible that there ſhould be either Sea or Land in the Moon: For ſince ſhe moves ſo ſwiftly as Aſtronomers obſerve, why then does there nothing fall from her, or why doth ſhe not ſhake ſomething out by the celerity of her Revolution? I anſwer, You muſt know that the inclination of every heavy Body to its proper Center, doth ſufficiently tye it unto its place; ſo that ſuppoſe any thing were ſeparated, yet muſt it neceſſarily return again. And there is no more danger of their falling into our World, than there is fear of our falling into the Moon.

But yet there are many Fabulous Relations of ſuch Things as have dropped thence. There is a Tale of the *Nemean* Lyon that *Hercules* ſlew, which firſt ruſhing among the Herds out of his unknown Den in the

Vide Guli. Nubrigenſ de rebus Anglica. lib. 1.

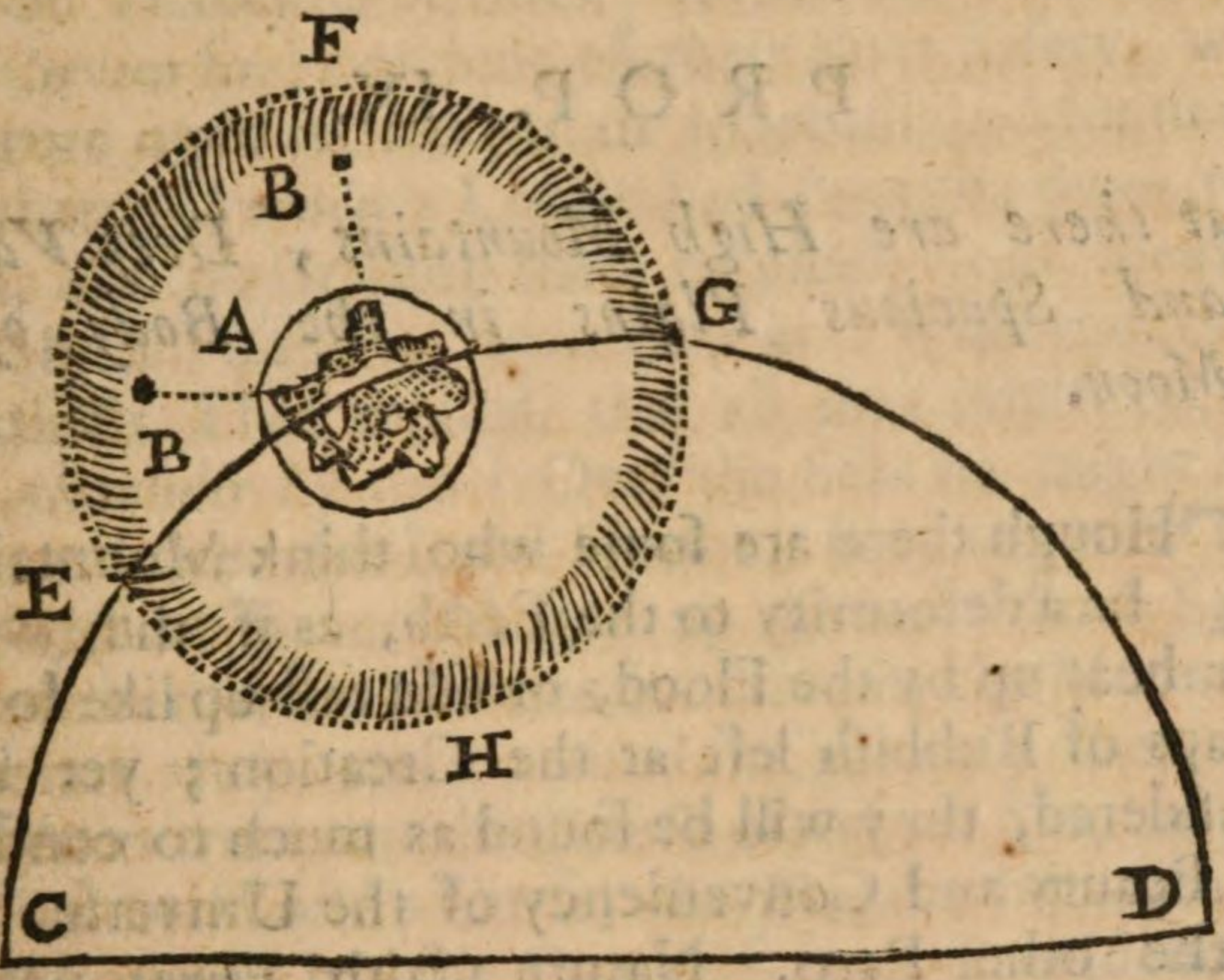
the Mountain of *Cytheron* in *Bœotia*, the Credulous People thought he was ſent from their Goddeſs the Moon. And if a Whirlwind did chance to ſnatch any thing up, and afterwards rain it down again, the ignorant Multitude were apt to believe that it dropt from Heaven. Thus *Avicenna* relates the Story of a Calf which fell down in a Storm, the Beholders thinking it a Moon-Calf, and that it fell thence. So *Cardan* travelling upon the *Apennine* Mountains, a ſudden Blaſt took off his Hat, which if it had been carried far, he thinks the Peaſants, who had perceived it to fall, would have ſworn it had rained Hats. After ſome ſuch manner many of our Prodigies come to paſs, and the People are willing to believe any thing which they may relate to others as a very ſtrange and wonderful Event. I doubt not but the *Trojan Palladium*, the *Roman Minerva*, and our Lady's Church at *Loretto*, with many Sacred Relicks preſerv'd by the *Papiſts*, might drop from the Moon as well as any of theſe.

But it may be again objected, Suppoſe there were a Bullet ſhot up in that World, would not the Moon run away from it before it could fall down, ſince the Motion of her Body (being every Day round our Earth) is far ſwifter than the other, and ſo the Bullet muſt be left behind, and at length fall down to us? To this I anſwer,

1. If a Bullet could be ſhot ſo far till it came to the Circumference of thoſe Things which belong to our Center, then it would fall down to us.

2. Though there were ſome heavy Body a great Height in that Air, yet would the Motion of that Magnetical Globe to which it did belong, by an attractive Virtue ſtill hold it within its convenient diſtance, ſo that whether their Earth moved or ſtood ſtill, yet would the ſame Violence caſt a Body from it equally far. That I may the plainer expreſs my Meaning, I will ſet down this Diagram.

Suppoſe



Suppoſe this Earth were A, which was to move in the Circle C, D, and let the Bullet be ſuppoſed at B, within its proper Verge; I ſay, whether this Earth did ſtand ſtill, or move ſwiftly towards D, yet the Bullet would ſtill keep at the ſame diſtance, by reaſon of that Magnetick Virtue of the Center (if I may ſo ſpeak) whereby all Things within its Sphere are attracted with it. So that the violence to the Bullet, being nothing elſe but that whereby 'tis removed from its Center, therefore an equal Violence can carry a Body from its proper Place but at an equal diſtance, whether or no this Earth where its Center is, does ſtand ſtill or move.

The Impartial Reader may find ſufficient ſatisfaction for this and ſuch other Arguments as may be urged againſt the Motion of that Earth, in the Writings of *Copernicus* and his Followers; unto whom, for brevity ſake, I will refer them.

PROP. IX.

That there are High Mountains, Deep Vallies, and Spacious Plains in the Body of the Moon.

THough there are ſome who think Mountains to be a deformity to the Earth, as if they were either beat up by the Flood, or elſe caſt up like ſo many Heaps of Rubbiſh left at the Creation; yet if well conſidered, they will be found as much to conduce to the Beauty and Conveniency of the Univerſe, as any of the other Parts. Nature (ſaith *Pliny*) purpoſely framed them for many excellent uſes; partly to tame the Violence of greater Rivers, to ſtrengthen certain Joints within the Veins and Bowels of the Earth, to break the Force of the Seas Inundation, and for the ſafety of the Earth's Inhabitants, whether Beaſts or Men. That they make much for the protection of Beaſts, the Pſalmiſt teſtifies; *The higheſt Hills are a refuge for the Wild Goats, and the Rocks for Conies.* The Kingly Prophet had likewiſe learned the ſafety of theſe by his own experience, when he alſo was fain to make a Mountain his Refuge from the Fury of his Maſter *Saul*, who perſecuted him in the Wilderneſs.

Nat. Hiſt. l. 36. *c.* 5.

Pſal. 104. *v.* 18.

True indeed, ſuch Places as theſe keep their Neighbours poor, as being moſt barren, but yet they preſerve them ſafe, as being moſt ſtrong; witneſs our unconquered *Wales* and *Scotland*, whoſe greateſt Protection hath been the natural Strength of their Countrey; ſo fortify'd with Mountains, that theſe have always been unto them ſure Retreats from the Violence and Oppreſſion of others. Wherefore a good Author doth rightly call them Nature's Bulwarks, caſt

up

up at God Almighty's own Charges, the Scorns and Curbs of Victorious Armies. Which made the *Barbarians* in *Curtius* ſo confident of their own Safety, when they were once retired to an inacceſſible Mountain; that when *Alexander*'s Legate had brought them to a Parley, and perſwading them to yield, told them of his Maſter's Victories, what Seas and Wilderneſſes he had paſſed; They replied, that all that might be, but could *Alexander* fly too? Over the Seas he might have Ships, and over the Land Horſes, but he muſt have Wings before he could get up thither. Such Safety did thoſe barbarous Nations conceive in the Mountains whereunto they were retired. Certainly then ſuch uſeful Parts were not the Effect of Man's Sin, or produced by the World's Curſe, the Flood; but rather at the firſt created by the Goodneſs and Providence of the Almighty.

This Truth is uſually concluded from theſe and the like Arguments.

1. Becauſe the Scripture it ſelf, in the Deſcription of that general Deluge, tells us, it overflowed the higheſt Mountains.

2. Becauſe *Moſes* who writ long after the Flood, does yet give the ſame Deſcription of Places and Rivers, as they had before; which could not well have been if this had made ſo ſtrange an Alteration.

3. 'Tis evident that the Trees did ſtand as before. For otherwiſe, *Noah* could not ſo well have concluded, that the Waters were abated, from this Reaſon, becauſe the Dove brought an Olive Leaf in her Mouth, when ſhe was ſent forth the Second Time: Whereas had the Trees been rooted up, ſhe might have taken it the Firſt Time, from one of them as it was floating on the Top of the Waters. Now if the Motion of the Water was not ſo violent as to ſubvert the Trees, much leſs was it able to caſt up ſuch vaſt Heaps as the Mountains.

4. When the Scripture doth ſet forth unto us the

Power and Immenſity of God by the Variety or Uſefulneſs of the Creatures which he hath made; amongſt the reſt it doth often mention the Mountains. *Pſal.* 104. 8. *item*, 148. 9. *Iſa.* 40. 12. And therefore 'tis probable they were created at the firſt. Unto this I might add that in other Places, Divine Wiſdom in ſhewing of its own Antiquity, ſaith that he was *from the beginning, before the earth or the mountains were brought forth.*

Prov. 8. 25.
Pſal. 90. 2.

5. If we may truſt the Relations of Antiquity, there were many Monuments left undefaced after the Flood.

Joſeph Ant. l. 1. cap. 3.

So that if I intend to prove that the Moon is ſuch a habitable World as this is; 'tis requiſite that I ſhew it to have the ſame Conveniences of Habitation as this hath. And here if ſome *Rabbi* or Chymick were to handle the Point, they would firſt prove it out of Scripture, from that Place in *Moſes* his Bleſſing, where he ſpeaks of the Ancient Mountains and laſting Hills, *Deut.* 33. תרדיקרם וגבעות עולם for having immediately before mentioned thoſe Bleſſings which ſhould happen unto *Joſeph* by the Influence of the Moon, he does preſently exegetically iterate them, in bleſſing him with the chief things of the ancient Mountains and laſting Hills; you may alſo ſee the ſame Expreſſion uſed in *Jacob's* Bleſſing of *Joſeph*.

Gen. 49. 26.

But however we may deal *pro* or *con* in Philoſophy, yet we muſt not be too bold with Divine Truths, or bring Scripture to patronize any Fancy of our own; though, (perhaps) it be a Truth. I am not of their Mind, who think it a good Courſe to confirm Philoſophical Secrets from the Letter of the Scripture, or by abuſing ſome obſcure Text in it. Methinks it ſavours too much of that Melancholly Humor of the Chymicks, who, aiming in all their Studies at the making of Gold, do perſuade themſelves, that the moſt Learned and Subtile of the Ancient Authors, in

all

all their obſcure Places do mean ſome ſuch Senſe as may make to their Purpoſe. And hence it is that they derive ſuch ſtrange Myſteries from the Fables of the Poets; and can tell you what great Secret it was, that Antiquity did hide under the Fiction of *Jupiter* being turned into a Shower of Gold: Of *Mercury*'s being made the Interpreter of the Gods: Of the *Moon*'s deſcending to the Earth for the Love of *Endymion*: With ſuch ridiculous Interpretations of theſe and the like Fables, which any reaſonable conſidering Man cannot conceive to proceed from any but ſuch as are diſtracted. No leſs fantaſtical in this kind are the *Jewiſh Rabbies*; amongſt whom, is not any Opinion, whether in Nature or Policy, whether true or falſe, but ſome of them, by a Cabaliſtical Interpretation can father it upon a dark Place of Scripture, or (if need be) upon a Text that is clean contrary. There being not any Abſurdity ſo groſs and incredible, for which theſe Abuſers of the Text, will not find out an Argument. Whereas, 'tis the more natural Way, and ſhould be obſerved in all Controverſies, to apply unto every thing the proper Proofs of it; and when we deal with Philoſophical Truths, to keep our ſelves within the Bounds of Human Reaſon and Authority.

But this by the way. For the better Proof of this Propoſition, I might here cite the Teſtimony of *Diodorus*, who thought the Moon to be full of rugged Places, *velut terreſtribus tumulis ſupercilioſam*; but he erred much in ſome Circumſtances of this Opinion, eſpecially where he ſays, there is an Iſland amongſt the *Hyperboreans*, wherein thoſe Hills may to the Eye be plainly diſcovered; and for this reaſon * *Cælius* calls him a fabulous Writer. But you may ſee more expreſs Authority for the Proof of this in the Opinions of *Anaxagoras* and *Democritus*, who held that this Planet was full of champion Grounds, Mountains and Vallies. And this ſeemed likewiſe probable unto *Auguſtinus Nifus*,

* *Lect. aut.* l. 1. c. 15.

Plut. de plac. l. 2. c. 25.

De Cælo. l. 2. part. 49.

fus, whoſe Words are theſe : *Forſitan non eſt remotum dicere lunæ partes eſſe diverſas, veluti ſunt partes terræ, quarum aliæ ſunt valloſæ, aliæ montoſæ, ex quarum differentia effici poteſt facies illa lunæ ; nec eſt rationi diſſonum, nam luna eſt corpus imperfecte Sphæricum, cum ſit corpus ab ultimo cælo elongatum, ut ſupra dixit Ariſtoteles.* " Perhaps, it " would not be amiſs to ſay that the Parts of the " Moon were divers, as the Parts of this Earth, where- " of ſome are Vallies, and ſome Mountains ; from the " Difference of which, ſome Spots in the Moon may pro- " ceed ; nor is this againſt Reaſon ; for that Planet " cannot be perfectly Spherical, ſince 'tis ſo remote a " Body from the firſt Orb, as *Ariſtotle* had ſaid before."

De Mundi fab. par. 3. c. 4.

You may ſee this Truth aſſented unto by *Blancanus* the Jeſuit, and by him confirmed with divers Reaſons. *Keplar* hath obſerved in the Moon's Eclipſes, that the Diviſion of her enlightned Part from the ſhaded, was made by a crooked unequal Line, of which there cannot be any probable Cauſe conceived, unleſs it did ariſe from the Ruggedneſs of that Planet ; for it cannot at all be produc'd from the Shade of any Mountains here upon Earth ; becauſe theſe would be ſo leſſened before they could reach ſo high in a conical Shadow, that they would not be at all ſenſible unto us (as might eaſily be demonſtrated) ; nor can it be conceived what reaſon of this Difference there ſhould be in the Sun. Wherefore there being no other Body that hath any thing to do in Eclipſes, we muſt neceſſarily conclude, that it is cauſed by a Variety of parts in the Moon it ſelf ; and what can theſe be but its Gibboſities? Now if you ſhould ask a Reaſon why there ſhould be ſuch a Multitude of theſe in that Planet, the ſame *Keplar* ſhall jeſt you out an Anſwer. Suppoſing (ſaith he) that thoſe Inhabitants are bigger than any of us, in the ſame Proportion as their Days are longer than ours, *viz.* by Fifteen Times ; it may be, for want of Stones to erect ſuch vaſt Houſes as were requiſite for their Bodies, they are fain to dig great and round Hol-

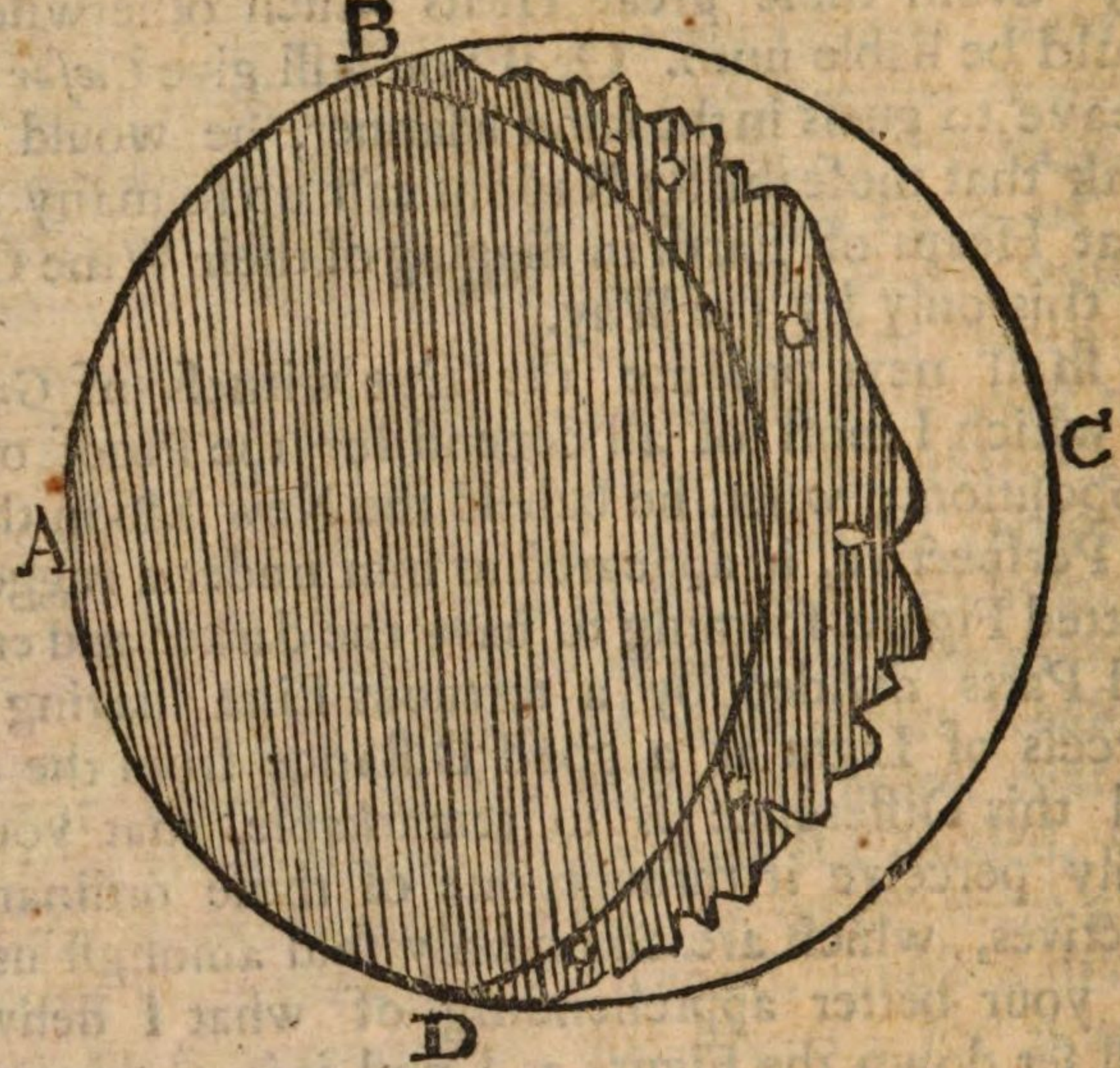
Aſtron. Opt. c. 6. num. 9.

lows

lows in the Earth; where they may both procure Water for their Thirſt, and turning about with the Shade, may avoid thoſe great Heats which otherwiſe they would be liable unto. Or if you will give *Cæſar la Galla* leave to gueſs in the ſame Manner, he would rather think that thoſe thirſty Nations caſt up ſo many and ſo great Heaps of Earth in digging of their Wine Cellars; but this only by the Way. *Kep. appen. Selenogra.*

I ſhall next produce the Eye-witneſs of *Galilæus*, on which I moſt of all depend for the Proof of this Propoſition; when he beheld the New Moon through his Perſpective, it appeared to him under a rugged and ſpotted Figure, ſeeming to have the darker and enlightned Parts divided by a tortuous Line, having ſome Parcels of Light at a good Diſtance from the other; and this Difference is ſo remarkable, that you may eaſily perceive it through one of thoſe ordinary Perſpectives, which are commonly ſold amongſt us; but for your better apprehending of what I deliver, I will ſet down the Figure as I find it in *Galilæus*. *Nuncius Sydereus.*

Suo-



Suppoſe *A B C D* to repreſent the Appearance of the Moon's Body being in a *Sextile*, you may ſee ſome brighter Parts ſeparated at a pretty Diſtance from the other, which can be nothing elſe but a Reflection of the Sun-beams upon ſome parts that are higher than the reſt; and thoſe obſcure Gibboſities which ſtand out towards the enlightened Parts, muſt be ſuch hollow and deep Places whereto the Rays cannot reach. But when the Moon is got farther off from the Sun, and come to that Fulneſs as this Line *B D* doth repreſent her under; then do theſe Parts alſo receive an equal Light, excepting only that Difference which doth appear betwixt their Sea and Land. And if you do conſider how any rugged Body would appear being enlightned, you would eaſily conceive that it muſt neceſſarily ſeem under ſome ſuch gibbous unequal Form, as

the

the Moon is here repreſented. Now for the Infallibility of theſe Appearances, I ſhall refer the Reader to that which hath been ſaid in the Sixth Propoſition.

But *Cæſar la Galla* affirms, that all theſe Appearances may conſiſt with a plain Superficies, if we ſuppoſe the Parts of the Body to be ſome of them *Diaphanous*, and ſome *Opacous*; and if you object that the Light which is convey'd to any Diaphanous Part in a plain Superficies, muſt be by a continued Line; whereas here there appear many brighter Parts among the obſcure at ſome Diſtance from the reſt: To this he anſwers, it may riſe from ſome ſecret Conveyances and Channels within her Body, that do conſiſt of a more Diaphanous Matter; which being covered over with an Opacous Superficies, the Light paſſing through them may break out a great way off; whereas the other Parts betwixt, may ſtill remain dark. Juſt as the River *Arethuſa* in *Sicily*, which runs under Ground for a great way, and afterwards breaks out again. But, becauſe this is one of the chiefeſt Fancies, whereby he thinks he hath fully anſwered the Argument of this Opinion, I will therefore ſet down his Anſwer in his own Words, leſt the Reader might ſuſpect more in them than I have expreſſed. *Non eſt impoſſibile cæcos ductus diaphani & perſpicui corporis, ſed opaca ſuperficie protendi, uſque in diaphanam aliquam ex profundo in ſuperficiem emergentem partem, per quos ductus lumen longo poſtmodum interſtitio erumpat, &c.* But I reply, if the Superficies betwixt theſe two enlightened Parts remain dark becauſe of its Opacity; then would it always be dark, and the Sun could not make it partake of Light more than it could of Perſpicuity. But this contradicts all Experience, as you may ſee in *Galilæus*, who affirms that when the Sun comes nearer to his Oppoſition, then that which is betwixt them both, is enlightened as well as either. Nay, this oppoſes his own Eye-witneſs; for he confeſſes himſelf that he ſaw this by the Glaſs. He had ſaid before, that he came to ſee thoſe ſtrange Cap. 11.

Sights

Sights di ſcovered by *Galilæus* his Glaſs, with an intent of Contradiction; and you may read that confirmed in the Weakneſs of this Anſwer, which rather bewrays an obſtinate, than a perſwaded Will; for otherwiſe ſure he would never have undertook to have deſtroyed ſuch certain Proof with ſo groundleſs a Fancy.

Syſt. mund. coll. 1. That Inſtance of *Galilæus*, would have been a better Evaſion, had this Author been acquainted with it; who might then have compared the Moon to that which we call Mother of Pearl, which though it be moſt exactly poliſhed in the Superficies of it; yet will ſeem unto the Eye as if there were divers ſwellings and riſings in its ſeveral Parts. But yet, this neither would not well have ſhifted the Experiment of the Perſpective. For theſe rugged Parts do not only appear upon one ſide of the Moon, but as the Sun does turn about in divers Places, ſo do they alſo caſt their Shadow. When the Moon is in her Increaſe, then do they caſt their Shadows to the *Eaſt*. When ſhe is in the Decreaſe, and the Sun on the other ſide of her, then likewiſe may we diſcover theſe brighter parts caſting their Shadows *Weſtward*. Whereas in the full Moon there are none of all theſe to be ſeen.

But it may be objected, that 'tis almoſt impoſſible, and altogether unlikely, that in the Moon there ſhould be any Mountains ſo high as thoſe Obſervations make them. For do but ſuppoſe according to the common Principles, that the Moon's Diameter unto the Earth's, is very near to the Proportion of Two to Seven. Suppoſe withal that the Earth's Diameter contains about 7000 *Italian* Miles, and the Moon's 2000 (as is commonly granted.) Now *Galilæus* hath obſerved, that ſome parts have been enlightned, when they were the Twentieth Part of the Diameter diſtant from the common Term of Illumination. From whence it muſt neceſſarily follow, that there may be ſome Mountains in the Moon ſo high, that they are able to caſt a Shadow

dow a Hundred Miles off. An Opinion that ſounds like a Prodigy or a Fiction; wherefore 'tis likely that either thoſe Appearances are cauſed by ſomewhat elſe beſides Mountains, or elſe thoſe are fallible Obſervations; from whence may follow ſuch improbable, inconceiveable Conſequences.

But to this I anſwer;

1. You muſt conſider the height of the Mountains is but very little, if you compare them to the length of their Shadows. Sir *Walter Rawleigh* obſerve that the Mount *Athos*, now called *Lacas*, caſts its Shadow 300 Furlongs, which is above 37 Miles; and yet that Mount is none of the higheſt. Nay *Solinus* (whom I ſhould rather believe in this kind) affirms that this Mountain gives his Shadow quite over the Sea, from *Macedon* to the Iſle of *Lemnos*, which is 700 Furlongs, or 84 Miles, and yet according to the common reckoning it doth ſcarce reach 4 Miles upwards in its perpendicular height.

Hiſt. l. 1. cap. 7. ſect. 11.

Poly. Hiſt. c. 21.

2. I affirm that there are very high Mountains in the Moon. *Keplar* and *Galilæus* think that they are higher than any which are upon our Earth. But I am not of their Opinion in this, becauſe I ſuppoſe they go upon a falſe Ground, whilſt they conceive that the higheſt Mountain upon the Earth is not above a Mile perpendicular.

Whereas 'tis the Common Opinion, and found true enough by obſervation, that *Olympus*, *Atlas*, *Taurus* and *Emus*, with many others, are much above this height. *Tenariffa* in the *Canary* Iſlands, is commonly related to be above 8 Miles perpendicular, and about this height (ſay ſome) is the Mount *Perjacaca* in *America*. * Sir *Walter Rawleigh* ſeems to think that the higheſt of theſe is near 30 Miles upright: Nay *Ariſtotle* ſpeaking of *Caucaſus* in *Aſia*, affirms it to be viſible for 560 Miles, as ſome Interpreters find by computation; from which it will follow, that it was 78 Miles perpendicularly high; as you may ſee confirmed by

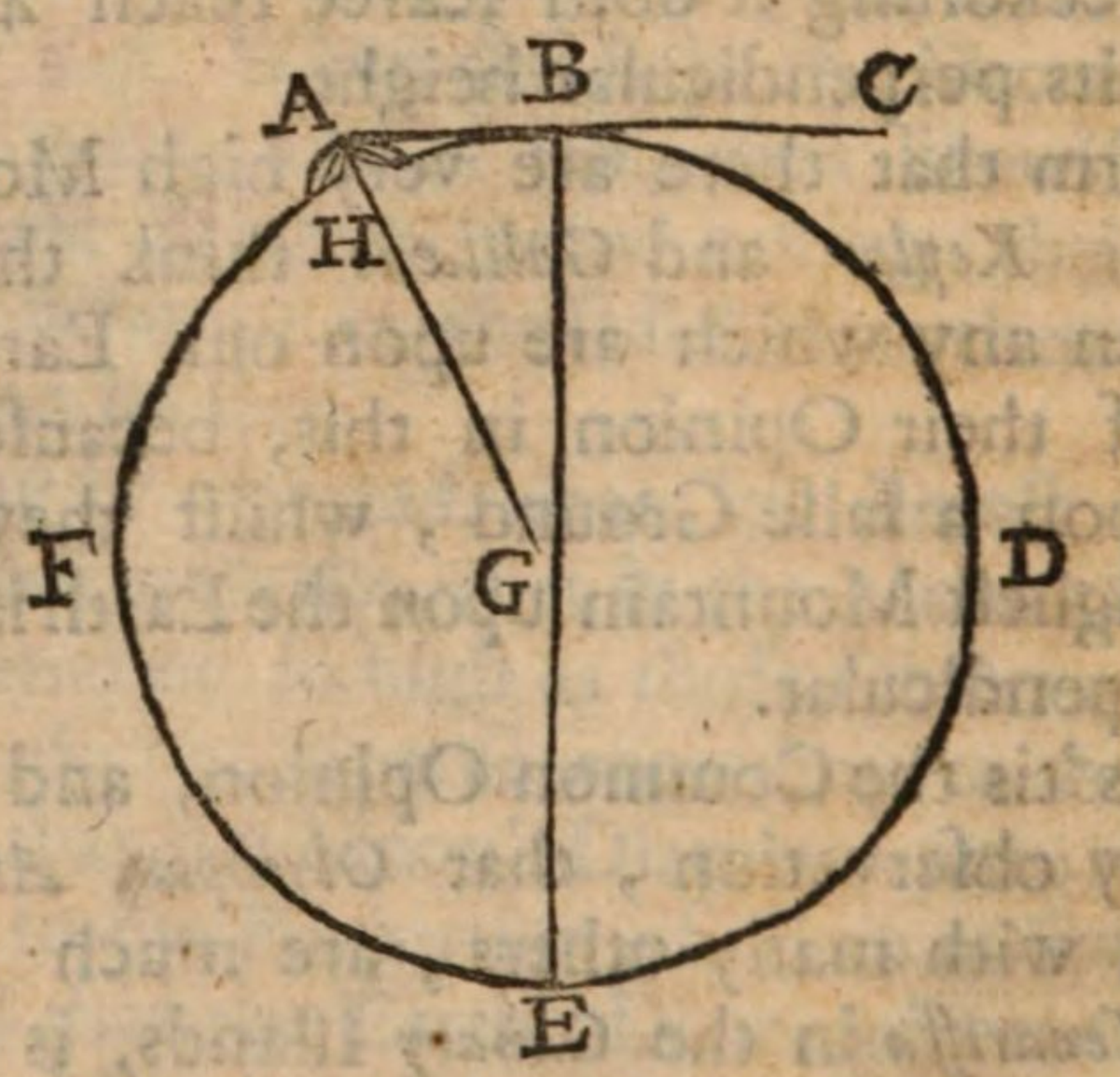
* *Hiſt. l. 1. c. 7. ſect. 11. Meteor. l. 1. c. 11.*

Jacobus

Comparatio Ariſt. cum. Platone, ſect. 3. c. 5. Expoſt. in loc. Math. Arlis loc. 148.

Jacobus Mazonius, and out of him in *Blancanus* the Jeſuit. But this deviates from the Truth more in exceſs than the other doth in defect. However, though theſe in the Moon are not ſo high as ſome amongſt us; yet certain it is they are of a great height, and ſome of them at the leaſt four Miles perpendicular. This I ſhall prove from the obſervation of *Galilæus*, whoſe Glaſs can ſhew to the Senſes a Proof beyond exception; and certainly that Man muſt needs be of a moſt timorous Faith, who dares not believe his own Eye.

By that Perſpective you may plainly diſcern ſome enlightned Parts (which are the Mountains) to be diſtant from the other about the twentieth part of the Diameter. From whence it will follow, that thoſe Mountains muſt neceſſarily be at the leaſt four *Italian* Miles in height.



For let B D E F be the Body of the Moon, A BC will be a Ray or Beam of the Sun, which enlightens a Mountain at A, and B is the Point of Contingency; the diſtance betwixt A and B muſt be ſuppoſed to be the twentieth part of the Diameter, which is an 100 Miles, for ſo far are ſome enlightened Parts ſevered from the common Term of Illumination.

Now

Now the Aggregate of the Quadrate from A B a hundred, and B G 1000 will be 1010000 ; unto which the Quadrate arising from A G must be equal ; according to the 47th Proposition in the First Book of Elements. Therefore the whole Line A G is somewhat more than 104, and the distance betwixt H A must be above 4 Miles, which was the Thing to be proved.

But it may be again objected, If there be such rugged Parts, and so high Mountains, why then cannot we discern them at this distance? Why doth the Moon appear unto us so exactly round, and not rather as a Wheel with Teeth?

I answer, by reason of too great a distance ; for if the whole Body appear to our Eye so little, then those Parts which bear so small a proportion to the whole, will not at all be sensible.

But it may be reply'd, if there were any such remarkable Hills, why does not the Limb of the Moon appear like a Wheel with Teeth, to those who look upon it through the great Perspective, on whose Witness you so much depend ? Or what Reason is there that she appears as exactly round through it, as she doth to the bare Eye ? Certainly then either there is no such thing as you imagine, or else the Glass fails much in this Discovery.

To this I shall answer out of *Galilæus*.

1. You must know, that there is not meerly one Rank of Mountains above the edge of the Moon, but divers Orders, one Mountain behind another, and so there is somewhat to hinder those void spaces which otherwise, perhaps, might appear.

Now, where there be many Hills, the Ground seems even to a Man that can see the tops of all. Thus when the Sea rages, and many vast Waves are lifted up, yet all may appear plain enough to one that stands at the Shore. So where there are so many Hills, the

inequality will be leſs remarkable, if it be diſcerned at a diſtance.

2. Though there be Mountains in that Part which appears unto us to be the Limb of the Moon, as well as in any other Place, yet the bright Vapours hide their appearance; For there is an Orb of thick vaporous Air that doth immediately compaſs the Body of the Moon; which though it have not ſo great opacity, as to terminate the Sight, yet being once enlightned by the Sun, it doth repreſent the Body of the Moon under a greater Form, and hinders our Sight from a diſtinct View of her true Circumference. But of this in the next Chapter.

Somn. Aſtr. not. 207.

3. *Keplar* hath obſerved, That in the Solary Eclipſes, when the Rays may paſs through this Vaporous Air, there are ſome Gibboſities to be diſcerned in the Limb of the Moon.

I have now ſufficiently proved, that there are Hills in the Moon; and hence it may ſeem likely that there is alſo a World: For ſince Providence hath ſome ſpecial End in all its Works, certainly then theſe Mountains were not produced in vain; and what more probable Meaning can we conceive there ſhould be, than to make that Place convenient for habitation.

PROP. X.

That there is an Atmo-ſphæra, or an Orb of Groſs, Vaporous Air immediately encompaſſing the Body of the Moon.

AS that Part of our Air which is neareſt to the Earth is of a thicker Subſtance than the other, by reaſon 'tis always mixed with ſome Vapours which are

are continually exhaled into it: So is it equally requiſite, that if there be a World in the Moon, that the Air about that ſhould be alike qualify'd with ours. Now that there is ſuch an Orb of Groſs Air, was firſt of all (for ought I can read) obſerved by *Meſlin*, afterwards aſſented unto by *Keplar* and *Galilæus*, and ſince by *Baptiſta Cittacus*, *Scheiner*, with others, all of them confirming it by the ſame Arguments; which I ſhall only cite, and then leave this Propoſition. *Vide Euſeb. Nicrem. de Nat. Hiſt. l. 2. c. 11.*

1. 'Tis not improbable that there ſhould be a Sphere of Groſſer Air about the Moon; becauſe 'tis obſerv'd that there are ſuch kind of Evaporations which proceed from the Sun it ſelf. For there are diſcovered divers moveable Spots, like Clouds, that do encompaſs his Body; which thoſe Authors who have been moſt frequently verſed in theſe kind of Experiments and Studies, do conclude to be nothing elſe but Evaporations from it. The probability and truth of which Obſervations may alſo be inferred from ſome other Appearances. As,

1. It hath been obſerved that the Sun hath ſometimes for the ſpace of four Days together, appear'd as dull and ruddy almoſt as the Moon in her Eclipſes; inſomuch that the Stars have been ſeen at Mid-day. Nay, he hath been conſtantly darkned for almoſt a whole Year, and never ſhined but with a kind of heavy and duskiſh Light, ſo that there was ſcarce Heat enough to ripen the Fruits. As it was about the Time when *Cæſar* was killed. Which was recorded by ſome of the Poets. Thus *Virgil*, ſpeaking of the Sun. So A. D. 1547. *April* 24 to the 28.

Ille etiam extincto miſeratus Cæſare Romam,
Cum caput obſcura nitidum ferrugine texit,
Impiaq; æternam timuerunt ſæcula Noctem.

Virgil, Georg. l. 1.

He pitying Rome *when as* Great Cæſar *dy'd,*
His Head within a Mourning Vail did hide.

And thus the Wicked Guilty World did fright
With doubtful Fears of an Eternal Night.

Ovid likewiſe ſpeaking of his Death,

Metam. lib. 15.

——Solis quoque triſtis imago
Lurida ſollicitis præbebat lumina terris.

——The Sun's ſad Image then
Did yield a lowring Light to fearful Men.

Now theſe Appearances could not ariſe from any lower Vapour: For then, 1. They would not have been ſo univerſal as they were, being ſeen through all *Europe*: Or elſe, 2. That Vapour muſt have covered the Stars as well as the Sun, which yet notwithſtanding were then plainly diſcerned in the Day time. You may ſee this Argument illuſtrated in another the like Caſe, Chap. 12. Hence then it will follow, that this fuliginous Matter, which did thus obſcure the Sun, muſt needs be very near his Body; and if ſo, then what can we more probably gueſs it to be than Evaporations from it?

2. 'Tis obſerved, that in the Sun's total Eclipſes, when there is no part of his Body diſcernible, yet there does not always follow ſo great a Darkneſs as might be expected from his total abſence. Now 'tis probable that the Reaſon is, becauſe theſe thicker Vapours being enlightened by his Beams, do convey ſome Light unto us, notwithſtanding the interpoſition of the Moon betwixt his Body and our Earth.

3. This likewiſe is by ſome gueſs'd to be the reaſon of the *crepuſculum*, or that Light which we have before the Sun's riſing.

Now if there be ſuch Evaporations from the Sun, much more then from the Moon, which does conſiſt of a more groſs and impure ſubſtance. The other

Arguments

Arguments are taken from ſeveral Obſervations in the Moon her ſelf, and do more directly tend to the proof of this Propoſition.

2. 'Tis obſerved, that ſo much of the Moon as is enlightened, is always part of a bigger Circle than that which is darker. The frequent Experience of others hath proved this, and an eaſy Obſervation may quickly confirm it. But now this cannot proceed from any other Cauſe ſo probable as from this Orb of Air; eſpecially when we conſider how that Planet ſhining with a borrowed Light, doth not ſend forth any ſuch Rays as may make her Appearance bigger than her Body.

3. When the Moon being half enlightened, begins to cover any Star, if the Star be towards the obſcurer Part, then may it by the perſpective be diſcerned to be nearer unto the Center of the Moon than the outward Circumference of the enlightned part. But the Moon being in the Full, then does it ſeem to receive theſe Stars without its Limb.

4. Though the Moon do ſometime appear the firſt Day of her Change, when ſo much as appears enlightned cannot be above the 80th part of her diameter, yet then will the Horns ſeem at leaſt to be of a Finger's breadth in extenſion; which could not be, unleſs the Air about it were illuminated.

5. 'Tis obſerved in the Solary Eclipſes, that there is ſometimes a great trepidation about the Body of the Moon, from which we may likewiſe argue an Atmoſphæra, ſince we cannot well conceive what ſo probable a Cauſe there ſhould be of ſuch an appearance as this, *Quod radii Solares à vaporibus Lunam ambientibus fuerint interciſi*, that the Sun-beams were broken and refracted by the Vapours that encompaſſed the Moon. *Scheiner. Roſ. Urſ. l. 4. part. 2. c. 27.*

6. I may add the like Argument taken from another Obſervation which will be eaſily try'd and granted. When the Sun is eclipſed, we diſcern the Moon as ſhe is in her own natural bigneſs; but then ſhe ap-

pears somewhat less than when she is in the Full, tho' she be in the same place of her supposed Excentrick and Epicycle; and therefore *Tycho* hath calculated a Table for the Diameter of the divers New Moons. But now there is no reason so probable to solve this Appearance, as to place an Orb of thicker Air near the Body of that Planet, which may be enlightned by the reflected Beams, and through which the direct Rays may easily penetrate.

But some may object, That this will not consist with that which was before delivered, where I said, that the thinnest parts had least Light.

If this were true, how comes it to pass then that this Air should be as light as any of the other Parts, when as 'tis the thinnest of all?

I answer, If the Light be received by Reflection only, then the thickest Body hath most, because it is best able to beat back the Rays; but if the Light be received by Illumination (especially if there be an Opacous Body behind, which may double the Beams by reflexion) as it is here, then I deny not but a thin Body may retain much Light; and perhaps some of those Appearances which we take for Fiery Comets, are nothing else but a Bright Cloud enlightned; so that probable it is there may be such Air without the Moon: And hence it comes to pass, that the greater Spots are only visible towards her middle Parts, and none near the Circumference; not but that there are some as well in those Parts as elsewhere, but they are not there perceivable, by reason of those brighter Vapours which hide them.

PROP.

PROP. XI.

That as their World is our Moon, ſo our World is their Moon.

I Have already handled the firſt thing that I promiſed, according to the Method which *Ariſtotle* uſes in his Book *De Mundo*; and ſhew'd you the neceſſary Parts that belong to this World in the Moon. In the next Place 'tis requiſite that I proceed to thoſe things which are extrinſical unto it, as the Seaſons, the Meteors, and the Inhabitants.

1. Of the Seaſons;

And if there be ſuch a World in the Moon, 'tis requiſite then that their Seaſons ſhould be ſome way correſpondent unto ours, that they ſhould have Winter and Summer, Night and Day, as we have.

Now that in this Planet there is ſome Similitude of Winter and Summer, is affirmed by *Ariſtotle* himſelf; *Degen. anim. l. 4. 12.* ſince there is one Hemiſphere that hath always Heat and Light, and the other that hath Darkneſs and Cold. True indeed, their Days and Years are always of one and the ſame Length; (unleſs we make one of their Years to be 19 of ours, in which Space all the Stars do ariſe after the ſame Order.) But 'tis ſo with us alſo under the Poles, and therefore that great difference is not ſufficient to make it altogether unlike ours; nor can we expect that every thing there ſhould be in the ſame Manner as it is here below, as if Nature had no way but one to bring about her purpoſes. We have no Reaſon then to think it neceſſary that both theſe Worlds ſhould be altogether alike; but it may ſuffice if they be correſpondent in ſomething only. However, it may be queſtioned whether it doth not ſeem to be againſt the Wiſdom of Providence, to make the Night of ſo great a Length, when they have ſuch a

Golden Number.

long time unfit for Work? I anſwer, no; ſince 'tis ſo, and more with us alſo under the Poles; and beſides, the general Length of their Night is ſomewhat abated in the Bigneſs of their Moon, which is our Earth. For this returns as great a Light unto that Planet, as it receives from it. But for the better Proof of this, I ſhall firſt free the Way from ſuch Opinions as might otherwiſe hinder the Speed of a clearer Progreſs.

Plut. de fac. lunæ.

Plutarch one of the chief Patrons of this World in the Moon, doth directly contradict this Propoſition; affirming, that thoſe who live there, may diſcern our World, as the Dregs and Sediment of all other Creatures; appearing to them through Clouds and foggy Miſts, and that altogether devoid of Light, being baſe and unmoveable; ſo that they might well imagine the dark Place of Damnation to be here ſituate, and that they only were the Inhabiters of the World, as being in the midſt betwixt Heaven and Hell.

To this I may anſwer, 'tis probable that *Plutarch* ſpake this inconſiderately, and without a Reaſon; which makes him likewiſe fall into another Abſurdity, when he ſays our Earth would appear immoveable; whereas queſtionleſs, though it did not, yet would it ſeem to move, and theirs to ſtand ſtill, as the Land doth to a Man in a Ship; according to that of the Poet:

Provehimur portu, terræque, urbeſque recedunt.

And I doubt not but that Ingenious Author would eaſily have recanted, if he had been but acquainted with thoſe Experiences which Men of later Times have found out, for the Confirmation of this Truth.

2. Unto him aſſents *Macrobius*, whoſe Words are theſe; *Terra accepto ſolis lumine clareſcit tantummodo, non relucet.* "The Earth is by the Sun-beams made bright, "but not able to enlighten any thing ſo far." And his Reaſon is, becauſe this being of a thick and groſs Matter, the Light is terminated in its Superficies, and cannot penetrate into the Subſtance; whereas the

Somn. Scip. l. 1. c. 19.

Moon

Moon doth therefore ſeem ſo bright to us, becauſe it receives the Beams within it ſelf. But the Weakneſs of this Aſſertion, may be eaſily manifeſt by a common Experience; for poliſhed Steel (whoſe Opacity will not give any Admittance to the Rays) reflects a ſtronger Heat than Glaſs, and ſo conſequently a greater Light.

3. 'Tis the general Conſent of Philoſophers, that the Reflection of the Sun-beams from the Earth doth not reach much above half a Mile high, where they terminate the firſt Region; ſo that to affirm they might aſcend to the Moon, were to ſay, there were but one Region of Air, which contradicts the proved and received Opinion.

Unto this it may be anſwered:

That it is indeed the common Conſent, that the Reflexion of the Sun-beams reach only to the ſecond Region; but yet ſome there are, and thoſe too, Philoſophers of good Note, who thought otherwiſe. Thus *Plotinus* is cited by *Cælius*, *Si concipias te in ſublime quopiam mundi loco, unde oculis ſubjiciatur terræ moles aquis circumfuſa, & ſolis ſyderumque radiis illuſtrata, non aliam profecto viſam iri probabile eſt, quam qualis modo viſatur lunaris globi ſpecies.* "If you conceive your ſelf to be "in ſome ſuch high Place, where you might diſcern "the whole Globe of the Earth and Water, when it "was enlightned by the Suns Rays, 'tis probable it "would then appear to you in the ſame ſhape as the "Moon doth now unto us." So *Paulus Foſcarinus*. *Terra nihil aliud eſt quàm altera Luna, vel Stella, taliſque nobis appareret, ſi ex convenienti elongatione eminus conſpiciretur, in ipſaque obſervari poſſent eadem aſpectuum varietates, quæ in Luna apparent.* "The Earth is nothing elſe "but another Moon or Star, and would appear ſo un-"to us if it were beheld at a convenient diſtance with "the ſame Changes and Varieties as there are in the "Moon." Thus alſo *Carolus Malapertius*, whoſe Words are theſe: *Terra hæc noſtra, ſi in luna conſtituti eſſemus, ſplen-*

Ant. lect. l. 1. c. 4.

In ep. ad Sebaſt. fantonum.

Præfat. ad Auſtriaca Syd.

ſplendida prorſus quaſi non ignobilis planeta, nobis appareret. "If we were placed in the Moon, and from thence "beheld this our Earth, it would appear unto us very "bright, like one of the nobler Planets." Unto

Meteor. l. 1. c. 2. art. 2.

theſe doth *Fromondus* aſſent, when he ſays, *Credo equidem quod ſi oculus quiſpiam in orbe lunari foret, globum terræ & aquæ inſtar ingentis ſyderis à ſole illuſtrem conſpiceret.* "I believe that this Globe of Earth and Water would "appear like ſome great Star to any one, who ſhould "look upon it from the Moon." Now this could not be, nor could it ſhine ſo remarkably, unleſs the Beams of Light were reflected from it. And therefore the ſame *Fromondus* expreſly holds, that the firſt Region of Air is there terminated, where the Heat cauſed by Reflexion begins to languiſh, whereas the Beams themſelves do paſs a great way further. The chief Argument which doth moſt plainly manifeſt this Truth, is taken from a common Obſervation which may be eaſily tried.

If you behold the Moon a little before or after the Conjunction, when ſhe is in a *Sextile* with the Sun, you may diſcern not only the part which is enlightned, but the reſt alſo to have in it a kind of a duskiſh Light; but if you chuſe out ſuch a Situation, where ſome Houſe or Chimney (being ſome Seventy or Eighty Paces diſtant from you) may hide from your Eye the enlightned Horns, you may then diſcern a greater and more remarkable ſhining in thoſe parts unto which the Sun-beams cannot reach; nay, there is ſo great a Light, that by the Help of a good Perſpective you may diſcern its Spots. In ſo much that *Blancanus* the Jeſuit ſpeaking of it, ſays, *Hæc experientia ita me aliquando fefellit, ut in hunc fulgorem caſu ac repente incidens, exiſtimarim novo quodam miraculo tempore adoleſcentis lunæ factum eſſe plenilunium.*" This Experiment did once ſo de-

De mundi fab. p. 3. c. 3.

"ceive me, that happening upon the Sight of this "Brightneſs upon a ſudden, I thought that by ſome "New Miracle the Moon had been got into her Full "a little after her Change.

But

But now this Light is not proper to the Moon; it doth not proceed from the Rays of the Sun which doth penetrate her Body, nor is it caused by any other of the Planets and Stars. Therefore it must necessarily follow, that it comes from the Earth. The two first of these I have already proved, and as for the last, it is confidently affirmed by *Cælius*, *Quod si in disquisitionem evocet quis, an lunari syderi lucem fœnerent planetæ item alii, asseverantur astruendum non fœnerare.* "If any "should ask whether the other Planets lend any Light "to the Moon? I answer, they do not." True indeed, the Noble *Tycho* discussing the Reason of this Light, attributes it to the Planet *Venus*; and I grant that this may convey some Light to the Moon; but that it is not the Cause of this whereof we now discourse, is of it self sufficiently plain; because *Venus* is sometimes over the Moon, when as she cannot convey any Light to that part which is turned from her.

Ant. Lect. l. 20. c. 5.

Progym. 1.

It doth not proceed from the fixed Stars; for then it would retain the same Light in Eclipses, whereas the Light at such times is more ruddy and dull. Then also the Light of the Moon would not be greater or lesser, according to its distance from the Edge of the Earth's Shadow, since it did at all times equally participate this Light of the Stars.

In brief, this is neither proper to the Moon, nor does it proceed from any Penetration of the Sun's Rays, or the shining of *Venus*, or the other Planets, or the fixed Stars. Now because there is no other Body in the whole Universe, save the Earth; it remains that this Light must necessarily be caused by that, which with a just Gratitude repays to the Moon such Illumination as it receives from her.

And as loving Friends equally participate of the same Joy and Grief, so do these mutually partake of the same Light from the Sun, and the same Darkness from

from the Eclipſes, being alſo ſeverally helped by one another in their greateſt Wants: For when the Moon is in Conjunction with the Sun, and her upper part receives all the Light, then her lower Hemiſphere (which would otherwiſe be altogether dark) is enlightened by the Reflexion of the Sun-beams from the Earth. When theſe two Planets are in Oppoſition, then that part of the Earth which could not receive any Light from the Sun-beams, is moſt enlightened by the Moon, being then in her Full; and as ſhe doth moſt illuminate the Earth when the Sun-beams cannot, ſo the grateful Earth returns to her as great (nay greater) Light when ſhe moſt wants it; ſo that always that viſible part of the Moon which receives nothing from the Sun, is enlightened by the Earth, as is proved by *Galilæus*, with many more Arguments, in that Treatiſe which he calls *Syſtema Mundi.* True indeed, when the Moon comes to a *Quartile*, then you can neither diſcern this Light; nor yet the darker part of her Body; and that for a double Reaſon;

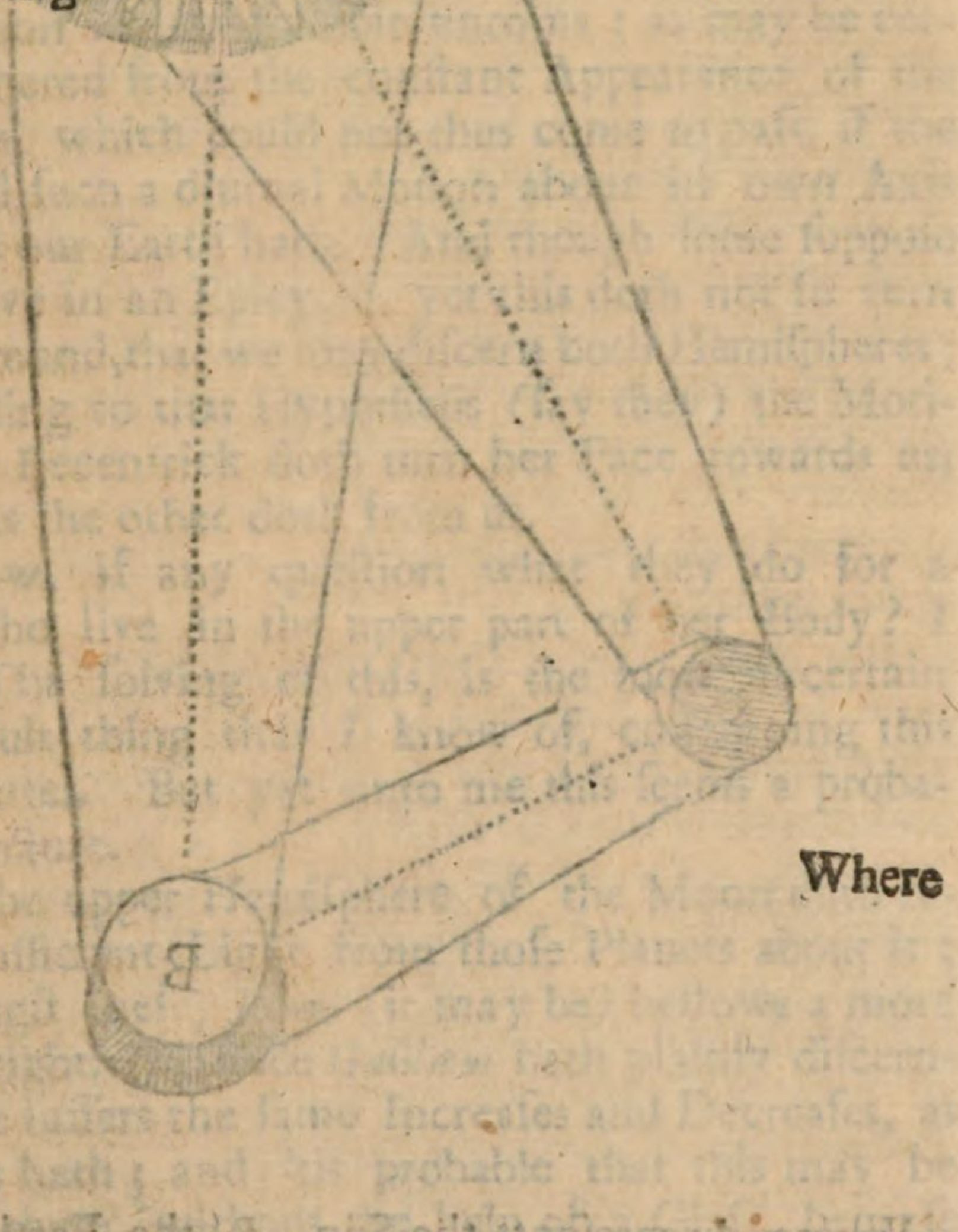
1. Becauſe the nearer it comes to the Full, the leſs Light does it receive from the Earth, whoſe Illumination does always decreaſe in the ſame Proportion as the Moon does increaſe.

2. Becauſe of the Exuberancy of the Light in the other parts. *Quippe illuſtratum medium ſpeciem recipit valentiorem*, the clearer Brightneſs involves the weaker; it being with the Species of Sight, as it is with thoſe of Sound; and as the greater Noiſe drowns the leſs, ſo the brighter Object hides that which is more obſcure. But as they do always in their mutual Viciſſitudes participate of one anothers Light; ſo alſo do they partake of the ſame Defects and Darknings; for when our Moon is eclipſed, then is their Sun darkned; and when our Sun is eclipſed, then is their Moon deprived of its Light, as you may ſee affirmed by *Meſlin.* *Quod ſi terram nobis ex alto liceret intueri, quemadmodum deficientem lunam ex longinquo ſpectare poſſumus, videremus tempore*

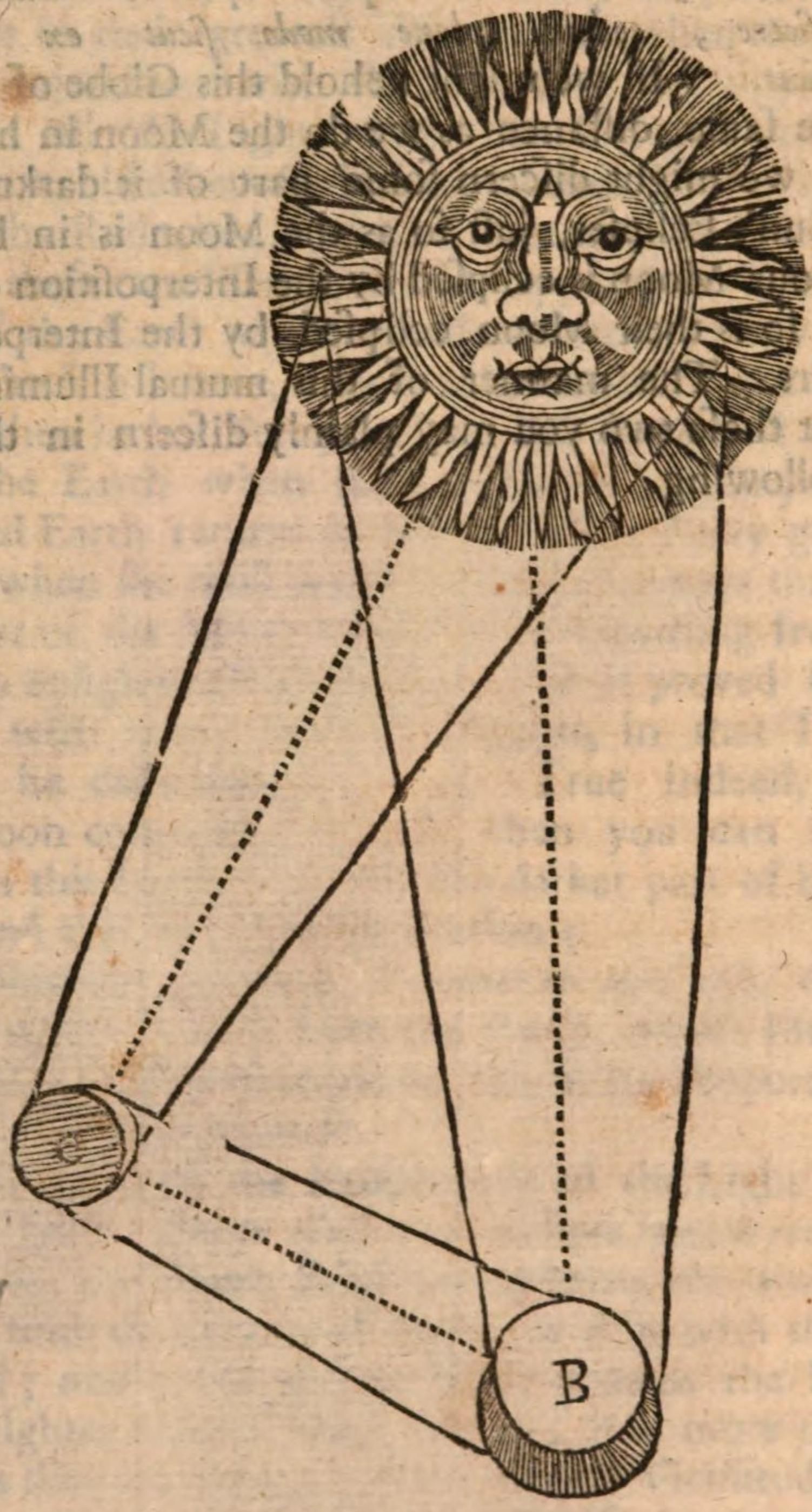
Scal. exerc. 62.

Epit. Aſtr. l. 4. part. 2.

pore eclipſis ſolis terræ aliquam partem lumine ſolis deficere, eodem plane modo ſicut ex oppoſito luna deficit. "If we might behold this Globe of Earth "at the ſame diſtance as we do the Moon in her De- "fect, we might diſcern ſome part of it darkned in "the Sun's Eclipſes, juſt ſo as the Moon is in hers." For as our Moon is eclipſed by the Interpoſition of our Earth, ſo is their Moon eclipſed by the Interpoſition of theirs. The manner of this mutual Illumination betwixt theſe two you may plainly diſcern in this Figure following.



Where



Where *A* repreſents the Sun, *B* the Earth, and *C* the Moon: Now ſuppoſe the Moon *C* to be in a *Sextile* of Increaſe, when there is only one ſmall part of her Body enlightened, then the Earth *B* will have ſuch a part

[a] part of its visible Hemisphere darkned, as is proportionable to that part of the Moon which is enlightned; and as for so much of the Moon, as the Sun-beams cannot reach unto, it receives Light from a proportional part of the Earth which shines upon it, as you may plainly perceive by the Figure.

You see then that Agreement and Similitude which there is betwixt our Earth and the Moon. Now the greatest difference which makes them unlike, is this, that the Moon enlightens our Earth round about, whereas our Earth gives Light only to that Hemisphere of the Moon which is visible unto us; as may be certainly gathered from the constant Appearance of the same Spots, which could not thus come to pass, if the Moon had such a diurnal Motion about its own Axis as perhaps our Earth hath. And though some suppose her to move in an Epicycle, yet this doth not so turn her Body round, that we may discern both Hemispheres; for according to that Hypothesis (say they) the Motion of her Eccentrick doth turn her Face towards us; as much as the other doth from us.

But now, if any question what they do for a Moon, who live in the upper part of her Body? I answer, The solving of this, is the most uncertain and difficult thing that I know of, concerning this whole Matter. But yet unto me this seems a probable Conjecture.

That the upper Hemisphere of the Moon doth receive a sufficient Light from those Planets about it; and amongst these, *Venus* (it may be) bestows a more especial brightness, since *Galilæus* hath plainly discerned that she suffers the same Increases and Decreases, as the Moon hath; and 'tis probable that this may be perceived there, without the help of a Glass, because they are far nearer it than we. When *Venus* (saith *Keplar*) lies down in the Perige or lower part of her supposed Epicycle, then is she in Conjunction with her Husband the Sun; from whom, after she

hath

hath departed for the ſpace of ten Months, ſhe gets *plenum uterum*, and is in the Full.

But you'll reply, Though *Venus* may beſtow ſome Light when ſhe is over the Moon, and in Conjunction, yet being in Oppoſition, ſhe is not viſible to them, and what ſhall they then do for Light?

I anſwer; Then they have none; nor doth this make ſo great a difference betwixt thoſe two Hemiſpheres, as there is with us betwixt the Places under the Poles and the Line. And beſides, 'tis conſiderable that there are two kind of Planets.

1. Primary; ſuch whoſe proper Circle do encompaſs the Body of the Sun, whereof there are ſix; *Saturn*, *Jupiter*, *Mars*, *Ceres*, or the *Earth*, *Venus*, *Mercury*. As in the Frontiſpiece.

2. Secondary; ſuch whoſe proper Circles are not about the Sun, but ſome of the other primary Planets. Thus are there two about *Saturn*, four about *Jupiter*, and thus likewiſe does the Moon encompaſs our Earth. Now 'tis probable that theſe leſſer ſecondary Planets, are not ſo accommodated with all Conveniencies of Habitation, as the others that are more principal.

But it may ſeem a very difficult thing to conceive, how ſo groſs and dark a Body as our Earth, ſhould yield ſuch a clear Light as proceeds from the Moon; and therefore the Cardinal *de Cuſa* (who thinks every Star to be a ſeveral World) is of Opinion, that the Light of the Sun is not able to make them appear ſo bright; but the reaſon of their ſhining is, becauſe we behold them at a great diſtance through their Regions of Fire, which do ſet a ſhining Luſtre upon thoſe Bodies that of themſelves are dark. *Unde ſi quis eſſet extra regionem ignis, terra iſta in circumferentia ſuæ regionis per medium ignis lucida ſtella appareret.* "So that if "a Man were beyond the Region of Fire, this Earth "would appear through that as a bright Star." But if this were the only Reaſon, then would the Moon

De doct. ig. l. 2. c. 12.

be

be freed from ſuch Increaſes and Decreaſes, as ſhe is now liable unto.

Keplar thinks that our Earth receives that Light whereby it ſhines, from the Sun; but this (ſaith he) is not ſuch an intended clear Brightneſs as the Moon is capable of, and therefore he gueſſes that the Earth there is of a more choaky Soil, like the Iſle of *Crete*, and ſo is better able to reflect a ſtronger Light; whereas our Earth muſt ſupply this Intention with the quantity of its Body. But this I conceive to be a needleſs Conjecture, ſince our Earth (if all things were well conſider'd) will be found able enough to reflect as great a Light. For,

1. Conſider its Opacity; if you mark theſe Sublunary things, you ſhall perceive that amongſt them, thoſe that are moſt perſpicuous, are not ſo well able to reverberate the Sun-Beams, as the thicker Bodies. The Rays paſs ſingly through a Diaphanous Matter, but in an Opacous Subſtance they are doubled in their return, and multiplied by Reflexion. Now if the Moon and the other Planets can ſhine ſo clearly by beating back the Sun-Beams, why may not the Earth alſo ſhine as well, which agrees with them in the cauſe of this Brightneſs, their Opacity?

2. Conſider what a clear Light we may diſcern reflected from the Earth in the midſt of Summer; and withal, conceive how much greater that muſt be which is under the Line, where the Rays are more directly and ſtrongly reverberated.

3. 'Tis conſiderable, that though the Moon does in the Night-time ſeem to be of ſo clear ā Brightneſs, yet when we look upon it in the Day, it appears like ſome little whitiſh Cloud: Not but that at both times, ſhe is of an equal Light in her ſelf. The reaſon of this Difference is, becauſe in the Night we look upon it through a dark and obſcure *Medium*, there being no other enlighten'd Body, whoſe Brightneſs may abate from this: Whereas in the Day-time, the whole Hea-

vens round about it are of an equal Clearneſs, and ſo make it to appear with a weaker Light. Now becauſe we cannot ſee how the enlighten'd Parts of our Earth do look in the Night, therefore in comparing it with the Moon, we muſt not conſider her, as ſhe is beheld through the advantage of a dark *Medium*, but as ſhe ſeems in the Day-time. Now, in any clear Sun-ſhine Day, our Earth does appear as bright as the Moon, which at the ſame time does ſeem like ſome duskiſh Cloud (as any little Obſervation may eaſily manifeſt.) Therefore we need not doubt but that the Earth is as well able to give Light, as the Moon. To this it may be added, that thoſe very Clouds, which in the Day-time ſeem to be of an equal Light to the Moon, do in the Evening become as dark as our Earth ; and as for thoſe of them which are looked upon at any great diſtance, they are often miſtaken for the Mountains.

4. 'Tis conſiderable, that though the Moon ſeem to be of ſo great a Brightneſs in the Night, by reaſon of its nearneſs unto thoſe ſeveral Shadows which it caſts, yet is it of it ſelf weaker than that part of Twilight, which uſually we have for half an Hour after Sun-ſet, becauſe we cannot till after that time diſcern any Shadow to be made by it.

5. Conſider the great diſtance at which we behold the Planets, for this muſt needs add much to their Shining ; and therefore *Cuſanus* (in the above-cited Place) thinks that if a Man were in the Sun, that Planet would not appear ſo bright to him, as now it doth to us, becauſe then his Eye could diſcern but little ; whereas here, we may comprehend the Beams as they are contracted in a narrow Body. *Keplar* beholding the Earth from a high Mountain, when it was enlighten'd by the Sun, confeſſes that it appeared unto him of an incredible Brightneſs, whereas then he could only ſee ſome ſmall parts of it ; but how much brighter would it have appeared, if he might

in a direct Line behold the whole Globe of Earth and these Rays gathered together? So that if we consider that great Light which the Earth receives from the Sun in the Summer, and then suppose we were in the Moon, where we might see the whole Earth hanging in those vast Spaces, where there is nothing to terminate the Sight, but those Beams which are there contracted into a little compass; I say, if we do well consider this, we may easily conceive that our Earth appears as bright to those other Inhabitants in the Moon, as theirs doth to us.

But here it may be objected, that with us for many Days in the Year, the Heavens are so over-clouded, that we cannot see the Sun at all; and for the most part, in our brightest Days, there are many scattered Clouds which shade the Earth in sundry Places: So that in this respect, it must needs be unlike the Moon, and will not be able to yield so clear, unintermitted a Light, as it receives from that Planet.

To this I Answer.

1. As for those lesser brighter Clouds, which for the most part are scattered up and down in the clearest Days, these can be no Reason why our Earth should be of a darker Appearance, because these Clouds being near unto the Earth, and so not distinguishable at so great a distance from it; and likewise being illuminated on their back Parts by the Sun that shines upon them, must seem as bright to those in the Moon, as if the Beams were immediately reflected from our Earth.

2. When these Clouds that are interposed, are of any large Extension, or great Opacity, as it is in extraordinary lasting and great Rains, then there must be some discernible Alteration in the Light of our Earth: But yet this does not make it to differ from the Moon, since it is so also with that Planet, as is shewed in the latter part of the next Chapter.

PROP. XII.

That 'tis probable there may be such Meteors belonging to that World in the Moon, as there are with us.

Plutarch discussing on this Point, affirms that it is not necessary there should be the same Means of Growth and Fructifying in both these Worlds, since Nature might in her Policy find out more ways than one how to bring about the same Effect. But however, he thinks it is probable that the Moon her self sendeth forth warm Winds; and by the swiftness of her Motion, there should breathe out a sweet and comfortable Air, pleasant Dews, and gentle Moisture, which might serve for Refreshing and Nourishment of the Inhabitants and Plants in that other World.

But since they have all things alike with us, as Sea and Land, and vaporous Air encompassing both; I should rather therefore think, that Nature there should use the same way of producing Meteors as she doth with us; and not by a Motion, (as *Plutarch* supposes) because she doth not love to vary from her usual Operations without some extraordinary Impediment, but still keeps her beaten Path, unless she be driven thence.

One Argument whereby I shall manifest this Truth, may be taken from those new Stars which have appeared in divers Ages of the World, and by their Paralax have been discerned to have been above the Moon; such as was that in *Cassiopeia*, that in *Sagittarius*, with many others betwixt the Planets. *Hipparchus* in his time took especial notice of such as these, and therefore fancied out such Constellations in which to place the Stars, shewing how many there were in every Asterism; that so afterwards, Posterity might know whether

Plin. Nat. Hist. l 2. c. 26.

whether there were any new Star produced, or any old one missing. Now the Nature of these Comets may probably manifest, that in this other World there are other Meteors also; for these in all likelihood, are nothing else but such Evaporations caused by the Sun from the Bodies of the Planets. I shall prove this by shewing the Improbabilities and Inconveniences of any other Opinion.

For the better pursuit of this, 'tis in the first place requisite, that I deal with our chief Adversary, *Cæsar la Galla*, who doth most directly oppose that Truth which is here to be proved. He endeavouring to confirm the Incorruptibility of the Heavens, and being there to satisfie the Argument which is taken from these Comets; He answers it thus: *Aut argumentum desumptum ex paralaxi, non est efficax, aut si est efficax, eorum instrumentorum usum decipere, vel ratione astri, vel medii, vel distantiæ, aut ergo erat in suprema parte aeris, aut si in cœlo, tum forsan factum erat ex reflectione radiorum Saturni & Jovis, qui tunc in conjunctione fuerant.* "Ei-
" ther the Argament from the Paralax is not efficaci-
" ous, or if it be, yet the use of the Instruments
" might deceive, either in regard of the Star, or the
" *Medium*, or the Distance, and so this Comet might
" be in the upper Regions of the Air; or if it were in
" the Heavens, there it might be produced by the Re-
" flexion of the Rays from *Saturn* and *Jupiter*, who
" were then in Conjunction." You see what Shifts he is driven to, how he runs up and down to many starting Holes that he may find some Shelter; and instead of the strength of Reason, he answers with a Multitude of Words, thinking (as the Proverb is) that he may use Hail when he hath no Thunder. *Nihil turpius* (saith * *Seneca*) *dubio & incerto, pedem modo referente, modo producente.* " What can there be more
" unseemly in one that should be a fair Disputant,
" than to be now here, now there, and so uncertain,
" that one cannot tell where to find him? He thinks

* *Epist.* 95.

that there are not Comets in the Heavens, becauſe there may be many other Reaſons of ſuch Appearances; but what, he knows not: Perhaps (he ſays) that Argument from the Paralax is not ſufficient; or if it be, then there may be ſome Deceit in the Obſervation. To this I may ſafely ſay, That he may juſtly be accounted a weak Mathematician, who miſtruſts the ſtrength of this Argument; nor can he know much in Aſtronomy, who underſtands not the Paralax, which is a Foundation of that Science: And I am ſure that he is a timerous Man, who dares not believe the frequent Experience of his Senſes, or truſt to a Demonſtration.

Vide Galilæum Syſt. mundi Colloq. 3.

True indeed, I grant 'tis poſſible that the Eye, the *Medium*, and the Diſtance, may all deceive the Beholder; but I would have him ſhew which of all theſe was likely to cauſe an Error in this Obſervation? Meerly to ſay they might be deceived, is no ſufficient Anſwer; for by this I might confute the Poſitions of all Aſtronomers, and affirm the Stars are hard by us, becauſe 'tis poſſible they might be deceived in their obſerving Diſtance. But I forbear any further Reply: My Opinion is of that Treatiſe, That either it was ſet forth purpoſely to tempt a Confutation, that he might ſee the Opinion of *Galilæus* confirmed by others; or elſe it was Invented with as much haſte and negligence as it was Printed, there being in it almoſt as many Faults as Lines.

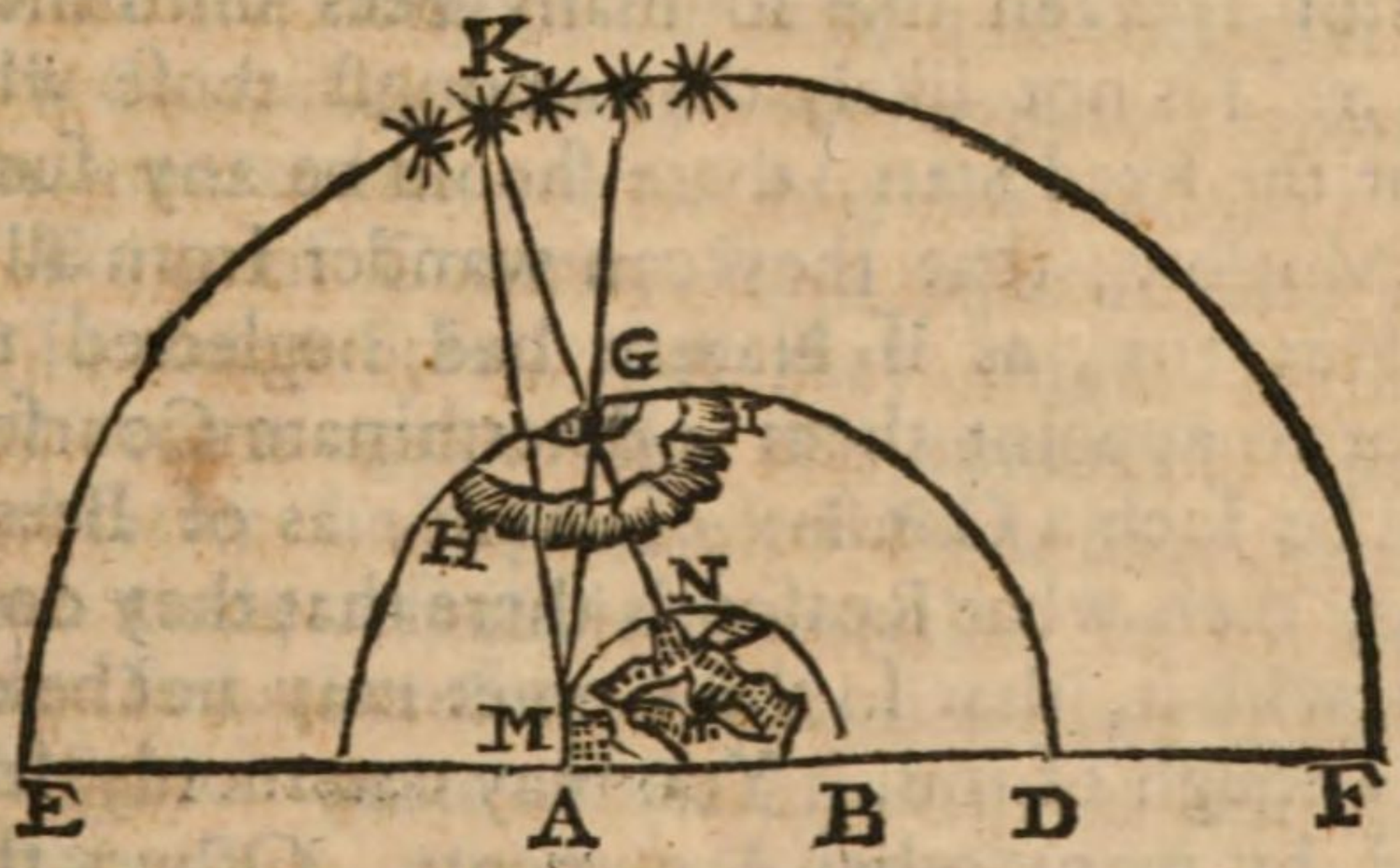
Others think that theſe are not any new Comets, but ſome ancient Stars that were there before, which now ſhine with that unuſual Brightneſs, by reaſon of the Interpoſition of ſuch Vapours, which do multiply their Light; and ſo the Alterarion will be here only, and not in the Heavens. Thus *Ariſtotle* thought the Appearance of the Milky Way was produced: For he held that there were many little Stars, which by their influence did conſtantly attract ſuch a Vapour towards that place of Heaven, ſo that it always appeared

peared white. Now by the ſame Reaſon may a brighter Vapour be the cauſe of theſe Appearances.

But how probable ſoever this Opinion may ſeem, yet if well conſidered, you ſhall find it to be altogether abſurd and impoſſible: For,

1. Theſe Stars were never ſeen there before; and 'tis not likely that a Vapour being hard by us, can ſo multiply that Light which could not before be at all diſcerned.

2. This ſuppoſed Vapour cannot be either contracted into a narrow compaſs, or dilated into a broad. 1. It could not be within a little ſpace, for then that Star would not appear with the ſame multiplied Light to thoſe in other Climates. 2. It cannot be a dilated Vapour, for then other Stars which were diſcerned through the ſame Vapour, would ſeem as big as that. This Argument is the ſame in effect with that of the Paralax, as you may ſee in this Figure.



Suppoſe *A B* to be a Hemiſphere of one Earth, *C D* to be the upper part of the higheſt Region, in which there might be either a contracted Vapour, as *G*, or elſe a dilated one, as *H I*. Suppoſe *E F* likewiſe to repreſent half the Heavens, wherein was this appear-

Bayerische Staatsbibliothek München

ing Comet at K. Now, I ſay, that a contracted Vapour, as G, could not cauſe this Appearance, becauſe an Inhabitant at M could not diſcern the ſame Star with this brightneſs, but perhaps another at L, betwixt which the Vapour is directly interpoſed. Nor could it be cauſed by a dilated Vapour, as H I, becauſe then all the Stars that were diſcerned through it, would be perceived with the ſame brightneſs.

'Tis neceſſary therefore that the Cauſe of this Appearance ſhould be in the Heavens. And this is granted by the moſt and beſt Aſtronomers. But, ſay ſome, this doth not argue any Natural Alteration in thoſe purer Bodies, ſince 'tis probable that the Concourſe of many little Vagabond Stars, by the union of their Beams may cauſe ſo great a Light. Of this Opinion were *Anaxagoras* and *Zeno* amongſt the Ancient, and *Baptiſta Ciſatus*, *Blancanus*, with others amongſt our Modern Aſtronomers. For, ſay they, when there happens to be a Concourſe of ſome few Stars, then do many other fly unto them from all the parts of Heaven like ſo many Bees unto their King. But 1. 'Tis not likely that amongſt thoſe which we count the fixed Stars, there ſhould be any ſuch uncertain Motions, that they can wander from all parts of the Heavens, as if Nature had neglected them, or forgot to appoint them a determinate Courſe. 2. If there be ſuch a Conflux of theſe, as of Bees to their King, then what Reaſon is there that they do not ſtill tarry with it, that ſo the Comet may not be diſſolv'd? But enough of this. You may commonly ſee it confuted by many other Arguments. Others there are, who affirm theſe to be ſome new created Stars, produced by an extraordinary Supernatural Power. I anſwer, True indeed, 'tis poſſible they might be ſo, but however 'tis not likely they were ſo, ſince ſuch Appearances may be ſolved ſome other way; wherefore to fly unto a Miracle for ſuch things, were a great injury to Nature, and to derogate from her Skill; an

Clavius in ſphæram. cap. 1.

Indignity

Indignity much misbecoming a Man who profeſſes himſelf to be a Philoſopher. *Miraculum* (ſaith one) *eſt ignorantiæ Aſylum*; a Miracle often ſerves for the Receptacle of a lazy Ignorance; which any Induſtrious Spirit would be aſham'd of; it being but an idle way to ſhift off the Labour of any further ſearch. But here's the miſery of it, we firſt tye our ſelves unto *Ariſtotle*'s Principles, and then conclude that nothing could contradict them but a Miracle; whereas 'twould be much better for the Commonwealth of Learning, if we would ground our Principles rather upon the frequent Experiences of our own, than the bare Authrity of others.

Some there are who think that theſe Comets are nothing elſe but Exhalations from our Earth, carry'd up into the higher parts of the Heaven. So *Peno*, *Rothmannus* and *Galilæus*. But this is not poſſible, ſince by computation 'tis found, that one of them is above 300 times bigger than the whole Globe of Land and Water. Others therefore have thought that they did proceed from the Body of the Sun, and that that Planet only is *Cometarum officina, unde tanquam emiſſarii & exploratores emitterentur, brevi ad ſolem redituri*: The Shop or Forge of Comets, from whence they were ſent, like ſo many Spies, that they might in ſome ſhort ſpace return again. But this cannot be, ſince if ſo much Matter had proceeded from him alone, it would have made a ſenſible diminution in his Body. The Noble *Tycho* therefore thinks that they conſiſt of ſome ſuch fluider parts of the Heaven, as the Milky Way is framed of, which being condens'd together, yet not attaining to the conſiſtency of a Star, is in ſome ſpace of time rarify'd again into its wonted Nature. But this is not likely, becauſe the appearance of the Milky Way does not ariſe from ſome fluider parts of the Heaven (as he ſuppoſes) but from the Light of many leſſer Stars which are thereabouts. And therefore it is uſually thus deſcribed: *Via lactea nihil*

Tycho Progym. l. c. 9.

Fromond. Meteor. l. 2. c. 5. art. 2.

Item Veſta tract. 5. c. 2.

nihil aliud eſt quam innumerabiles ſtellarum fixarum greges qui confuſo & pallenti lumine tractum illum inalbant. The Milky Way is nothing elſe but the pale and confuſed Light of many leſſer Stars, whereby ſome parts of the Heaven are made to appear white.

And beſide, what likely cauſe can we conceive of this condenſation, unleſs there be ſuch Qualities there as there are in our Air, and then why may not the Planets have the like Qualities as our Earth? And if ſo, then 'tis more probable that they are made by the ordinary way of Nature, as they are with us, and conſiſt of ſuch Exhalations from the Bodies of the Planets, as being very much rarified, may be drawn up through the Orb of Groſs Vaporous Air that encompaſſes them. Nor is this a ſingular Opinion; but it ſeemed moſt likely to *Camillus Glorioſus*, *Th. Campanella*, *Fromondus*, with ſome others. But if you ask, whither ſhall all theſe Exhalations return? I anſwer, every one into his own Planet. If it be again objected, that then there will be ſo many Centers of Gravity, and each ſeveral Planet will be a diſtinct World: I reply, we have not like probability concerning the reſt; but yet perhaps all of them are ſo, except the Sun, though *Cuſanus* and ſome others, think there is one alſo; and later Times have diſcovered ſome leſſer Clouds moving round about him. But as for *Saturn*, he hath two Moons on each ſide. *Jupiter* hath four, that encircle him with their Motion; which are likewiſe eclipſed by the interpoſition of his Body, as the Moon is by our Earth. *Venus* is obſerved to increaſe and decreaſe as the Moon. And this perhaps hath been noted by former Ages, as may be gueſs'd by that Relation of St. *Auſtin* out of *Varro*. *Mars*, and all the reſt, derive their Light from the Sun. Concerning *Mercury*, there hath been little or no obſervation, becauſe, for the moſt part, he lies hid under the Sun-beams, and ſeldom appears by himſelf. But when he does, yet the Compaſs of his Body is ſo little,

De Comet. l. 5. c. 4.
Apol. pro Galil.
Meteor. l. 3. c. 2. Art. 6.
Lactant. Inſt. l. 3. c. 23.
De Civit. De l. 21. cap. 8.

tle, and his Light of ſo clear a brightneſs, by reaſon of his nearneſs to the Sun, that the Perſpective cannot make the ſame diſcoveries upon him, as from the reſt.

So that if you conſider their Quantity, their Opacity, or theſe others Diſcoveries, you ſhall find it probable enough, that each of them may be a ſeveral World. Eſpecially ſince every one of them is allotted to a ſeveral Orb, and not altogether in one, as the fixed Stars ſeem to be. But this would be too much for to vent at the firſt: The chief thing at which I now aim in this Diſcourſe, is to prove tnat there may be one in the Moon.

It hath been before confirmed, that there was a Sphere of Thick Vaporous Air encompaſſing the Moon, as the firſt and ſecond Regions do this Earth. I have now ſhew'd, that thence ſuch Exhalations may proceed as do produce the Comets: Now from hence it may probably follow, that there may be Wind alſo and Rain, with ſuch other Meteors as are common amongſt us. This conſequence is ſo dependant, that *Fromondus* dares not deny it, though he would (as he confeſſes himſelf;) for if the Sun be able to exhale from them ſuch Fumes as may cauſe Comets, why not then ſuch as may cauſe Winds, and why not ſuch alſo as may cauſe Rain; ſince I have above ſhewed, that there is Sea and Land, as with us? Now Rain ſeems to be more eſpecially requiſite for them, ſince it may allay the Heat and Scorchings of the Sun when he is over their Heads. And Nature hath thus provided for thoſe in *Peru*, with the other Inhabitants under the Line.

De Meteor. l. 3. c. 2. Art. 6.

But if there be ſuch great and frequent Alterations in the Heavens, why cannot we diſcern them?

I anſwer:

1. There may be ſuch, and we not able to perceive them, becauſe of the weakneſs of our Eye, and the diſtance of thoſe Places from us; they are the Words of

of *Fienus* (as they are quoted by *Fromondus* in the above-cited Place) *Possunt maximæ permutationes in cælo fieri, etiamsi a nobis non conspiciantur; hoc visus nostri debilitas & immensa cœli distantia faciunt.* And unto him assents *Fromondus* himself, when a little after he says, *Si in sphæris Planetarum degeremus, plurima forsan cœlestium nebularum vellera toto æthere passim desperse videremus, quorum species jam evanescit nimiâ spatii intercapedine.* "If "we did live in the Spheres of the Planets, we might "there perhaps discern many great Clouds disperſed "through the whole Heavens, which are not now "visible by reason of this great distance.

2. *Mæstin* and *Keplar* affirm, That they have seen some of these Alterations. The Words of *Mæstin* are these (as I find them cited.) *In eclipsi Lunari vespere Dominicæ Palmarum Anni* 1605. *In corpore Lunæ versus Boream, nigricans quædam macula conspecta fuit, obscurior cætero toto corpore, quod candentis ferri figuram repræsentabat; dixisses nubila in multam regionem extensa pluviis & tempestuosis imbribus gravida, cujusmodi ab excelsorum montium jugis in humiliora convallium loca videre non rarò contingit.* "In that Lunary Eclipse which happened in "the Even of *Palm-Sunday*, in the Year 1605, there "wasa certain blackish Spot discerned in the Northerly part of the Moon, being darker than any other "place of her Body, and representing the Colour of "red hot Iron; you might conjecture that it was "some dilated Cloud, being pregnant with Showers; "for thus do such lower Clouds appear from the tops "of high Mountains.

Dissert. 2. cum nunc. Galil. item Somn. Astron. nota ultima.

And a little before this Passage, the same Author speaking of that Vaporous Air about the Moon, tells us; *Quod circumfluus ille splendor diversis temporibus appareret limpidior plus minusve.* That it does at divers times appear of a different clearness, sometimes more, and sometimes less; which he guesses to arise from the Clouds and Vapours that are in it.

Unto

Unto this I may add another Teſtimony of *Bapt. Ciſatus*, as he is quoted by *Nierembergius*, grounded upon an Obſervation taken 23 Years after this of *Mæſlin*, and writ to this *Euſeb. Nieremberg.* in a Letter by that diligent and judicious Aſtronomer. The Words of it run thus; *Et quidem in Eclipſi nupera ſolari quæ fuit ipſo die natali Chriſti, obſervavi clarè in luna ſoli ſuppoſita, quidpiam quod valde probat id ipſum quod Cometæ quoq; & maculæ ſolares urgent, nempe cœlum non eſſe à tenuitate & variationibus aeris exemptum; nam circa lunam adverti eſſe ſphæram ſeu orbem quendam vaporoſum, non ſecus atque circum terram, adeoq; ſicut ex terra in aliquam uſque ſphæram vapores & exhalationes expirant, ita quoque ex luna.* "In that late Solary Eclipſe which "happen'd on *Chriſtmas-day*, when the Moon was "juſt under the Sun, I plainly diſcerned that in her "which may clearly confirm what the Comet's and "Sun's Spots do ſeem to prove, *viz.* That the Hea-"vens are not ſo ſolid, nor freed from thoſe Changes "which our Air is liable unto; for about the Moon "I perceived ſuch an Orb, or Vaporous Air as that "is which doth encompaſs our Earth; and as Vapours "and Exhalations are raiſed from our Earth into this "Air, ſo are they alſo from the Moon.

Hiſtor. nat. l. 2. c. 11.

You ſee what probable Grounds, and plain Teſtimonies I have brought for the confirmation of this Propoſition: Many other Things in this behalf might be ſpoken, which for brevity ſake I now omit, and paſs unto the next.

PROP.

PROP. XIII.

That 'tis probable there may be Inhabitants in this other World; but of what kind they are, is uncertain.

I Have already handled the Seasons, and Meteors belonging to this New World: 'Tis requisite that in the next Place I should come unto the third Thing which I promised, and say somewhat of the Inhabitants: Concerning whom there might be many difficult Questions raised; as, whether that Place be more inconvenient for Habitation than our World (as *Keplar* thinks;) whether they are the Seed of *Adam*; whether they are there in a Blessed Estate, or else what means there may be for their Salvation? With many other such uncertain Enquiries, which I shall willingly omit; Leaving it to their Examination who have more Leisure and Learning for the Search of such particulars.

Being for mine one Part content only to set down such Notes belonging unto these, which I have observed in other Writers. *Cum tota illa regio nobis ignota sit, remanent inhabitatores illi ignoti penitus* (saith *Cusanus*;) since we know not the Regions of that Place, we must be altogether ignorant of the Inhabitants. There hath not yet been any such Discovery concerning these, upon which we may build a Certainty, or good Probability: Well may we guess at them, and that too very doubtfully, but we can know nothing; for, *if we do hardly guess aright at things which be upon Earth, if with labour we do find the things that are at hand, how then can we search out those things that are in Heaven?* What a little is that which we know, in respect of those many Matters contained within this great Universe? This whole Globe of Earth and Water, though it seem to us

De doct. ignorantia. l. 2. c. 12.

Wisd. 9. 16.

us to be of a large extent, yet it bears not ſo great a Proportion unto the whole Frame of Nature, as a ſmall Sand doth unto it; and what can ſuch little Creatures as we diſcern, who are tied to this point of Earth? or what can they in the Moon know of us? *If we underſtand any thing* (ſaith *Eſdras*) *'tis nothing but that which is upon the earth; and he that dwelleth above in the heavens, may only underſtand the things that are above in the height of the heavens.* 2 Eſd. 4. 21.

So that 'twere a very needleſs thing for us to ſearch after any particulars; however, we may gueſs in the general that there are ſome Inhabitants in that Planet: For why elſe did Providence furniſh that Place with all ſuch Conveniences of Habitation as have been above declared?

But you will ſay, perhaps, is there not too great and intolerable a heat, ſince the Sun is in their *Zenith* every Month, and doth tarry there ſo long before he leaves it?

I anſwer, 1. This may, perhaps, be remedied (as it is under the Line) by the Frequency of mid-day Showers, which may cloud their Sun, and cool their Earth.

2. The equality of their Nights doth much temper the ſcorching of the Day; and the extreme Cold that comes from the one, requires ſome ſpace before it can be diſpelled by the other; ſo that the Heat ſpending a great while before it can have the Victory, hath not afterwards much time to rage in. Wherefore notwithſtanding this doubt, yet that Place may remain habitable. And this was the Opinion of the *Cardinal de Cuſa*, when ſpeaking of this Planet, he ſays, *Hic locus Mundi eſt habitatio hominum & animalium atque vegetabilium.* "This part of the World is inhabited by Men, "and Beaſts, and Plants." To him aſſented *Campanella*; but he cannot determine whether they were Men or rather ſome other kind of Creatures. If they were Men, then he thinks they could not be infected *De doct. ign. l. 2. cap. 12.*

with

with *Adam*'s Sin; yet perhaps, they had ſome of their own, which might make them liable to the ſame miſery with us; out of which, it may be, they were delivered by the ſame means as we, the Death of Chriſt; and thus he thinks that Place of the *Epheſians* may be interpreted, where the Apoſtle ſays, *God gathered all things together in Chriſt, both which are in earth, and which are in the heavens*: So alſo that of the ſame Apoſtle to the *Coloſſians*, where he ſays, that *it pleaſed the Father to reconcile all things unto himſelf by Chriſt, whether they be things in earth, or things in heaven.*

Epheſ. 1. 10.

Col. 1.20.

But I dare not jeſt with Divine Truths, or apply theſe Places according as Fancy directs. As I think this Opinion doth not any where contradict Scripture; ſo I think likewiſe, that it cannot be proved from it. Wherefore *Campanella*'s ſecond Conjecture may be more probable, that the Inhabitants of that World are not Men as we are; but ſome other kind of Creatures which bear ſome Proportion and Likeneſs to our Natures. Or it may be, they are of a quite different Nature from any thing here below, ſuch as no Imagination can deſcribe; our Underſtandings being capable only of ſuch things as have entered by our Senſes, or elſe ſuch mixed Natures as may be compoſed from them. Now, there may be many other Species of Creatures beſide thoſe that are already known in the World; there is a great Chaſm betwixt the Nature of Men and Angels: It may be the Inhabitants of the Planets are of a middle Nature between both theſe. 'Tis not improbable that God might create ſome of all kinds, that ſo he might more compleatly glorify himſelf in the Works of his Power and Wiſdom.

Cuſanus too, thinks they differ from us in many Reſpects; I will ſet down his Words as they may be found in the above-cited Place, *Suſpicamur in regione ſolis magis eſſe ſolares, claros & illuminatos intellectuales habitatores, ſpiritualiores etiam quàm in luna, ubi magis lunatici, & in terra magis materiales & craſſi, ut illi intellectualis*

alis naturæ ſolares ſint multum in actu & parum in potentia, terreni vero magis in potentia, & parum in actu, lunares in medio fluctuantes. Hoc quidem opinamur ex influentia igniti ſolis, aquatica ſimul & aerea lunæ, & gravedine materiali terræ, & conſimiliter de aliis ſtellarum regionibus, ſuſpicantes nullam habitationibus carere, quaſi tot ſint partes particulares mundiales unius univerſi, quot ſunt ſtellæ quarum non eſt numerus, niſi apud eum qui omnia in numero creavit.

" We may conjecture (ſaith he) the Inhabitatants " of the Sun are like to the Nature of that Planet, " more clear and bright, more intellectual than thoſe " in the Moon where they are nearer to the Nature of " that duller Planet, and thoſe of the Earth being " more groſs and material than either ; ſo that theſe " intellectual Natures in the Sun, are more Form than " Matter, thoſe in the Earth more Matter than Form, " and thoſe in the Moon betwixt both. This we may " gueſs from the fiery Influence of the Sun, the wate- " ry and aereous Influence of the Moon, as alſo the " material Heavineſs of the Earth. In ſome ſuch " manner likewiſe is it with the Regions of the other " Stars ; for we conjecture that none of them are " without Inhabitants,but that there are ſo many parti- " cular Worlds and Parts of this one Univerſe, as " there are Stars, which are innumerable, unleſs it be " to him who created all things in Number.

For he held that the Stars were not all in one equal Orb as we commonly ſuppoſe; but that ſome were far higher than others, which made them appear leſs ; and that many others were ſo far above any of theſe, that they were altogether inviſible unto us. An Opinion which (as I conceive) hath not any great Probability for it, nor Certainty againſt it.

The Prieſt of *Saturn* relating to *Plutarch* (as he feigns it) the Nature of theſe *Selenites*, told him they were of divers Diſpoſitions, ſome deſiring to live in the lower Parts of the Moon, where they might look downwards upon us, while others were more ſurely

mounted aloft, all of them ſhining like the Rays of the Sun, and as being Victorious, are crowned with Garlands made with the Wings of *Euſtathia* or *Conſtancy*.

It hath been the Opinion amongſt ſome of the Ancients, that their Heavens and *Elyſian* Fields were in the Moon, where the Air is moſt quiet and pure. Thus *Socrates*, thus *Plato*, with his Followers, did eſteem this to be the Place where thoſe purer Souls inhabit, who are freed from the Sepulchre, and Contagion of the Body. And by the Fable of *Ceres*, continually wandring in Search of her Daughter *Proſerpina*, is meant nothing elſe but the longing Deſire of Men, who live upon *Ceres*, Earth, to attain a Place in *Proſerpina*, the Moon or Heaven.

Nat. Com. l. 3. c. 19.

Plutarch alſo ſeems to aſſent unto this; but he thinks moreover, that there are two Places of Happineſs anſwerable to two parts which he fancies to remain of a Man when he is dead, the Soul and the Underſtanding; the Soul he thinks is made of the Moon; and as our Bodies do ſo proceed from the Duſt of this Earth, that they ſhall return to it hereafter; ſo our Souls were generated out of that Planet, and ſhall be reſolved into it again; whereas the Underſtanding ſhall aſcend unto the Sun, out of which it was made; where it ſhall poſſeſs an Eternity of Well-being, and far greater Happineſs than that which is enjoyed in the Moon. So that when a Man dies, if his Soul be much polluted, then muſt it wander up and down in the middle Region of the Air where Hell is, and there ſuffer unſpeakable Torments for thoſe Sins whereof it is guilty. Whereas the Souls of better Men, when they have in ſome Space of Time been purged from that Impurity which they did derive from the Body, then do they return into the Moon, where they are poſſeſt with ſuch Joy, as thoſe Men feel who profeſs Holy Myſteries; from which Place (ſaith he) ſome are ſent down to have the Superintendance of Oracles, being dili-

diligent either in the Preſervation of the Good, either from, or in, all Perils, and the Prevention or Puniſhment of all wicked Actions; but if in theſe Employments they miſ-behave themſelves, then are they again to be impriſoned in a Body, otherwiſe they remain in the Moon, till their Souls be reſolved into it, and the Underſtanding being cleared from all Impediments, aſcends to the Sun which is its proper place. But this requires a diverſe Space of Time, according to the divers Affections of the Soul. As for thoſe who have been retired and honeſt, addicting themſelves to a ſtudious and quiet Life, theſe are quickly preferred to a higher Happineſs. But as for ſuch who have buſied themſelves in many Broils, or have been vehement in the Proſecution of any Luſt, as the ambitious, the amorous, the wrathful Man, theſe ſtill retain the Glimpſes and Dreams of ſuch things as they have performed in their Bodies, which make them either altogether unfit to remain there, where they are, or elſe keeps them long ere they can put off their Souls. Thus you ſee *Plutarch*'s Opinion concerning the Inhabitants and Neighbours of the Moon, which (according to the Manner of the Academicks) he delivers in a third Perſon; you ſee he makes that Planet an inferior kind of Heaven; and though he differs in many Circumſtances, yet doth he deſcribe it to be ſome ſuch Place, as we ſuppoſe Paradiſe to be. You ſee likewiſe his Opinion concerning the Place of the Damned Spirits, that it is in the middle Region of the Air; and in neither of theſe is he ſingular, but ſome more late and Orthodox Writers have agreed with him. As for the Place of Hell, many think it may be in the Air, as well as any where elſe.

True indeed, St. *Auſtin* affirms that this Place cannot be diſcovered; but others there are who can ſhew the Situation of it out of Scripture; ſome holding it to be in another World without this, becauſe our Sa- *De Civit. Dei l.* 22. *c.* 16.

Mat. 25. 30. *Eph.* 4. 9. viour calls it σκότος ἐξώτερον, outward Darkneſs. But the moſt will have it placed towards the Center of our Earth, becauſe 'tis ſaid, Chriſt deſcended into the lower Parts of the Earth: And ſome of theſe are ſo confident that this is its Situation, that they can deſcribe you its Bigneſs alſo, and of what Capacity it is. *Francis Ribera* in his Comment on the *Revelations*, ſpeaking of thoſe Words, where 'tis ſaid, *That the blood went out of the Wine-preſs, even unto the Horſes Bridles, by the ſpace of one thouſand and ſix hundred Furlongs*, interprets them to be meant of Hell, and that that Number expreſſes the Diameter of its Concavity, which is 200 *Italian* Miles. But *Leſſius* thinks that this Opinion gives them too much room in Hell, and therefore he gueſſes that 'tis not ſo wide; for, ſaith he, the Diameter of one League being cubically multiplied, will make a Sphere capable of 800000 Millions of Damned Bodies, allowing to each ſix Foot in the ſquare; whereas, ſays he, tis certain, that there ſhall not be One hundred thouſand Millions in all that ſhall be Damned. You ſee the bold *Jeſuit* was careful that every one ſhould have but room enough in Hell; and by the ſtrangeneſs of the Conjecture, you may gueſs that he had rather be abſurd, than ſeem either uncharitable or ignorant. I remember there is a Relation in *Pliny*, how that *Dionyſiodorus* a Mathematician being dead, did ſend a Letter from this Place to ſome of his Friends upon Earth, to certifie them what diſtance there was betwixt the Center and Superficies: He might have done well to have prevented this Controverſie, and informed them the utmoſt Capacity of that Place. However, certain it is, that that Number cannot be known; and probable it is, that the Place is not yet determined, but that Hell is there where there is any Tormented Soul, which may be in the Regions of the Air, as well as in the Center; and therefore perhaps it is, that the Devil is ſtiled the Prince of the Air. But of this only occaſionally, and

Rev. 14. 20.

De Morib. div. l. 13. *c.* 24.

by

by reaſon of *Plutarch*'s Opinion concerning thoſe that are round about the Moon. As for the Moon it ſelf, he eſteems it to be a lower kind of Heaven; and therefore in another place he calls it a Terreſtrial Star, and an Olympian or Cæleſtial Earth; anſwerable, as I conceive, to the Paradiſe of the Schoolmen. And, that Paradiſe was either in, or near the Moon, is the Opinion of ſome later Writers, who derived it (in all likelihood) from the Aſſertion of *Plato*, and perhaps, this of *Plutarch*. *Toſtatus* lays this Opinion upon *Iſidor*. *Hiſpalenſis*, and the venerable *Bede*, and *Pererius*, fathers it upon *Strabus* and *Rabanus* his Maſter. Some would have it to be ſituated in ſuch a place as could not be diſcovered; which cauſed the Penman of *Eſdras* to make it a harder Matter *to know the out-goings of Paradiſe, than to weigh the weight of the Fire, or meaſure the blaſts of Wind, or call again a Day that is paſt.* But notwithſtanding this, there be ſome others, who think that it is on the top of ſome high Mountain under the Line; and theſe interpreted the Torrid Zone to be the Flaming Sword whereby Paradiſe was guarded. 'Tis the Conſent of divers others, that Paradiſe is ſituated in ſome high and eminent Place. So *Toſtatus*: *Eſt etiam Paradiſus ſitu altiſſima, ſupra omnem terræ altitudinem.* "Paradiſe is ſituated in ſome high place a-"bove the Earth." And therefore in his Comment upon the 49th. of *Geneſis*, he underſtands the Bleſſing of *Jacob* concerning the Everlaſting Hills, to be meant of Paradiſe, and the Bleſſing it ſelf to be nothing elſe but a Promiſe of Chriſt's Coming, by whoſe Paſſion the Gates of Paradiſe ſhould be opened. Unto him aſſented *Rupertus*, *Scotus*, and moſt of the other Schoolmen, as I find them cited by *Pererius*, and out of him in Sir *Walter Rawleigh*. Their Reaſon was this: Becauſe in probability, this Place was not overflowed by the Flood, ſince there were no Sinners there, which might draw that Curſe upon it. Nay, *Toſtatus* thinks that the Body of *Enoch* was kept there; and ſome of

Cur ſilent oracula.

Sir *W. Raw. l.* 1. *c.* 3. *ſect.* 7. *In Geneſ.*

2 *Eſdr.* 4. 7.

In Geneſ.

Comment. in 2. *Gen. v.* 8. *L.* 1. *c.* 3. *ſect.* 6, 7.

the Fathers, as *Tertullian* and *Austin*, have affirmed, That the Blessed Souls were reserved in that Place till the Day of Judgment; and therefore 'tis likely that it was not overflowed by the Flood. It were easie to produce the unanimous Consent of the Fathers, to prove that Paradise is yet really existent. Any diligent Peruser of them, may easily observe how they do generally interpret the Paradise whereto St. *Paul* was wrapt, and that wherein our Saviour promised the Thief should be with him, to be locally the same from whence our first Parents were banished. Now there cannot be any Place on Earth designed where this should be; and therefore it is not altogether improbable that it was in this other World.

2 *Cor.* 12.4. *Luke* 23. 43.

And besides, since all Men should have went Naked if *Adam* had not fell, 'tis requisite therefore that it should be situated in some such Place where it might be privileged from the Extremities of Heat and Cold. But now this could not be (they thought) so conveniently in any lower, as it might in some higher Air. For these and such like Considerations, have so many affirmed that Paradise was in a high elevated Place: Which some have conceived could be no where but in the Moon: For it could not be in the top of any Mountain; nor can we think of any other Body separated from this Earth, which can be a more convenient Place for Habitation than this Planet; therefore they concluded that it was there.

It could not be on the top of any Mountain:

Gen. 7. 19. 1. Because we have express Scripture, that the highest of them was overflowed.

2. Because it must be of a greater Extension, and not some small Patch of Ground, since 'tis likely all Men should have lived there, if *Adam* had not fell. But for a satisfaction of the Arguments, together with a farther Discourse of Paradise, I shall refer you to those who have written purposely upon this Subject. Being content for my own part to have spoken so much

much of it, as may conduce to ſhew the Opinion of others concerning the Inhabitants of the Moon; I dare not my ſelf affirm any thing of theſe *Selenities*, becauſe I know not any Ground whereon to build any probable Opinion. But I think that future Ages will diſcover more; and our Poſterity, perhaps, may invent ſome Means for our better Acquaintance with theſe Inhabitants.

PROP. XIV.

That 'tis poſſible for ſome of our Poſterity, to find out a Conveyance to this other World; and if there be Inhabitants there, to have Commerce with them.

ALL that hath been ſaid concerning the People of the new World, is but Conjectural, and full of Uncertainties; nor can we ever look for any evident or more probable Diſcoveries in this kind, unleſs there be ſome hopes of inventing Means for our Conveyance thither. The poſſibility of which, ſhall be the Subject of our Enquiry in this laſt Propoſition.

And, if we do but conſider by what Steps and Leiſure, all Arts do uſually riſe to their growth, we ſhall have no cauſe to doubt why this alſo may not hereafter be found out amongſt other Secrets. It hath conſtantly yet been the Method of Providence, not preſently to ſhew us all, but to lead us on by degrees, from the knowledge of one thing to another.

'Twas a great while e'er the Planets were diſtinguiſhed from the fixed Stars; and ſome time after that, e'er the Morning and Evening Star were found to be the ſame; and in greater ſpace (I doubt not) but this alſo, and other as excellent Myſteries will be diſcovered. Time, who hath always been the Father of

new Truths, and hath revealed unto us many things which our Anceſtors were ignorant of, will alſo manifeſt to our Poſterity that which we now deſire, but cannot know. *Veniet tempus* (ſaith *Seneca*) *quo iſta quæ nunc latent, in lucem dies extrahet, & longioris ævi diligentia.* Time will come, when the Endeavours of After-Ages ſhall bring ſuch things to Light, as now lie hid in Obſcurity. Arts are not yet come to their Solſtice; but the Induſtry of future Times, aſſiſted with the Labours of their Forefathers, may reach that height which we could not attain to. *Veniet tempus quo poſteri noſtri nos tam aperta neſciſſe mirentur.* As we now wonder at the Blindneſs of our Anceſtors, who were not able to diſcern ſuch things as ſeem plain and obvious unto us; ſo will our Poſterity admire our Ignorance, in as perſpicuous Matters.

Nat. Qu. l. 7. c. 25.

In the firſt Ages of the World, the Inlanders thought themſelves either to be the only Dwellers upon Earth, or elſe if there were any other, they could not poſſibly conceive how they might have any Commerce with them, being ſevered by the deep and broad Sea. But After-times found out the Invention of Ships; in which notwithſtanding, none but ſome bold daring Men durſt venture, according to that of the Tragœdian.

Audax nimium qui freta primus
Rate tam fragili perfida rupit.

Too bold was he, who in a Ship ſo frail,
Firſt ventur'd on the treacherous Waves to Sail.

Sen. Med. act. 1.
Vide Hora. Od. 3.
Juvenal. ſat. 12.
Claud. præf. ad 1. lib. de rap. Proſer.

And yet now, how eaſie a thing is this even to a timorous and cowardly Nature? And queſtionleſs, the Invention of ſome other Means for our Conveyance to the Moon, cannot ſeem more incredible to us, than this did at firſt to them; and therefore we have no juſt reaſon to be diſcouraged in our hopes of the like Succeſs.

Yea,

Yea, but (you will ſay) there can be no Sailing thither, unleſs that were true which the Poet does but feign, That ſhe made her Bed in the Sea. We have not now any *Drake*, or *Columbus*, to undertake this Voyage, or any *Dædalus* to invent a Conveyance through the Air.

I anſwer, Though we have not, yet why may not ſucceeding Times raiſe up ſome Spirits as eminent for new Attempts, and ſtrange Inventions, as any that were before them? 'Tis the Opinion of *Keplar*, That as ſoon as the Art of Flying is found out, ſome of their Nation will make one of the firſt Colonies that ſhall tranſplant into that other World. I ſuppoſe his appropriating this Preheminence to his own Countreymen, may ariſe from an over-partial affection to them. But yet thus far I agree with him, That whenever that Art is invented, or any other, whereby a Man may be convey'd ſome twenty Miles high, or thereabouts, then 'tis not altogether improbable that ſome or other may be ſucceſsful in this Attempt. *Differta. cum Nun. Syder.*

For the better clearing of which I ſhall firſt lay down, and then anſwer thoſe Doubts that may make it ſeem utterly impoſſible.

Theſe are chiefly Three.

The Firſt, taken from the natural heavineſs of a Man's Body, whereby it is made unfit for the Motion of Aſcent, together with the vaſt diſtance of that Place from us.

2. From the extreme Coldneſs of the Æthereal Air.

3. The extreme Thinneſs of it.

Both which muſt needs make it impaſſible, though it were but as many ſingle Miles thither as it is thouſands.

For the firſt. Though it were ſuppoſed that a Man could fly, yet we may well think he would be very ſlow in it, ſince he hath ſo heavy a Body, and

ſuch

ſuch a one too, as Nature did not principally intend for that kind of Motion. 'Tis uſually obſerved, that amongſt the variety of Birds, thoſe which do moſt converſe upon the Earth, and are ſwifteſt in their running, as a Pheaſant, Partridge, *&c.* together with all Domeſtical Fowl, are leſs able for flight than others which are for the moſt part upon the Wing, as a Swallow, Swift, *&c.* And therefore we may well think, that Man being not naturally endowed with any ſuch Condition as may enable him for this Motion; and being neceſſarily tied to a more eſpecial Reſidence on the Earth, muſt needs be ſlower than any Fowl, or leſs able to hold out. Thus it is alſo in Swimming; which Art though it be grown to a good eminence, yet he that is beſt skilled in it, is not able either for continuance, or ſwiftneſs to equal a Fiſh; becauſe he is not naturally appointed to it. So that though a Man could fly, yet he would be ſo ſlow in it, and ſo quickly weary, that he could never think to reach ſo great a Journey as it is to the Moon.

But ſuppoſe withal that he could fly as faſt and long as the ſwifteſt Bird, yet it cannot poſſibly be conceived how he ſhould ever be able to paſs through ſo vaſt a diſtance as there is betwixt the Moon and our Earth. For this Planet, according to the common Grounds, is uſually granted to be at the leaſt 52 Semidiameters of the Earth from us; reckoning for each Semidiameter 3456 *Engliſh* Miles, of which the whole Space will be about 179712.

So that though a Man could conſtantly keep on in his Journey thither by a ſtrait Line, though he could fly a Thouſand Miles in a Day, yet he would not arrive thither under 180 Days, or half a Year.

And how were it poſſible for any to tarry ſo long without Diet or Sleep?

Prop. 3. 1. For Diet. I ſuppoſe there could be no truſting to that Fancy of *Philo* the *Jew* (mentioned before,) who

who thinks that the Muſick of the Spheres ſhould ſupply the ſtrength of Food.

Nor can we well conceive how a Man ſhould be able to carry ſo much Luggage with him, as might ſerve for his *Viaticum* in ſo tedious a Journey.

2. But if he could, yet he muſt have ſome time to reſt and ſleep in. And I believe he ſhall ſcarce find any Lodgings by the way. No Inns to entertain Paſſengers, nor any Caſtles in the Air (unleſs they be enchanted ones) to receive Poor Pilgrims, or Errant Knights. And ſo conſequently he cannot have any poſſible hopes of reaching thither.

Notwithſtanding all which Doubts, I ſhall lay down this Poſition.

That ſuppoſing a Man could fly, or by any other means raiſe himſelf twenty Miles upwards, or thereabouts, it were poſſible for him to come unto the Moon.

As for thoſe Arguments of the firſt kind, that ſeem to overthrow the truth of this, they proceed upon a wrong ground; whilſt they ſuppoſe that a condenſed Body, in any place of the Air, would always retain in it a ſtrong Inclination of tending downwards towards the Center of this Earth. Whereas 'tis more probable, that if it were but ſomewhat above this Orb of Vaporous Air, it might there reſt immovable, and would not have in it any propenſion to this Motion of Deſcent.

For the better illuſtration of this, you muſt know, that the heavineſs of a Body, or (as *Ariſtotle* defines it) the proneneſs of it to tend down unto ſome Center, is not any abſolute Quality intrinſical unto it, as if where-ever the Body did retain its Eſſence, it muſt alſo retain this Quality: Or as if Nature had implanted in every condenſed Body *Appetitionem centri, & fugam extremitatis.* Such a Love to the Center, and Hatred to the Extremities. Becauſe one of theſe being leſs

De cælo, lib. 4. c. 1.

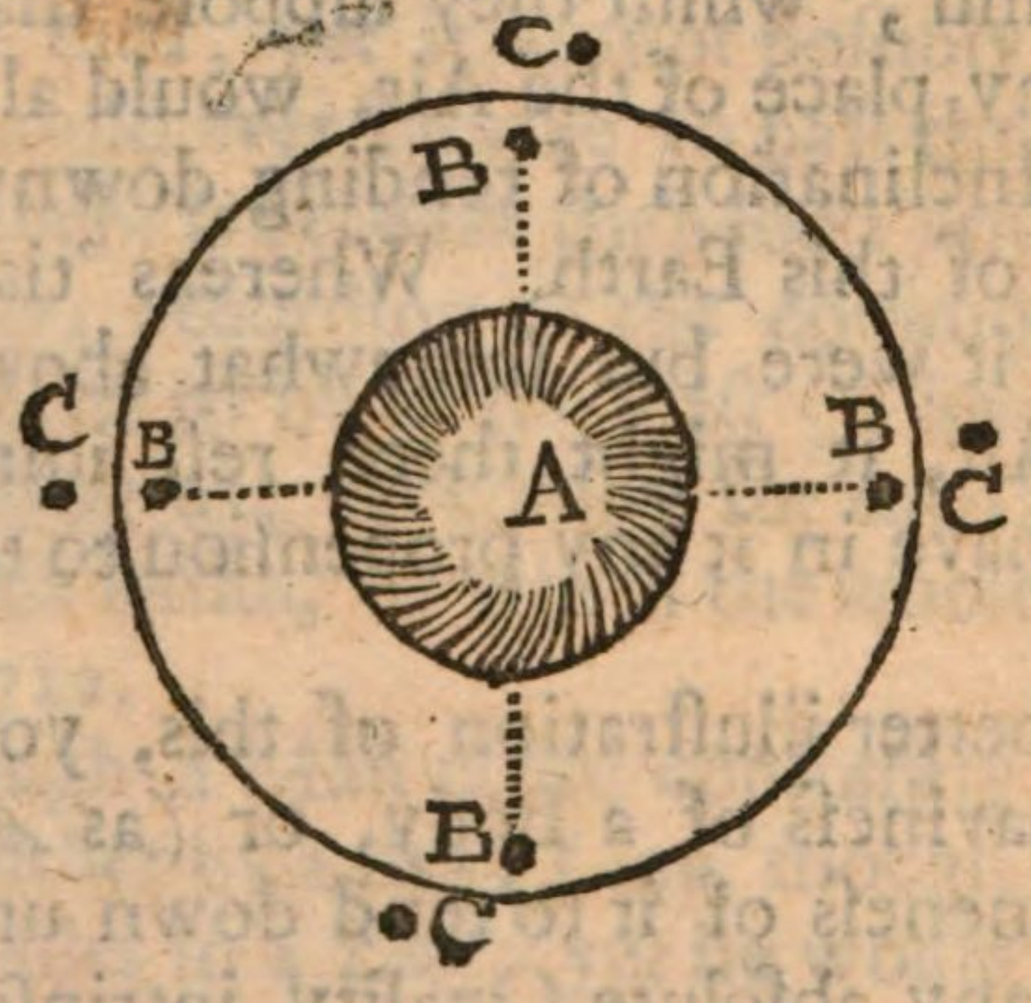
leſs than a Quantity, and the other no more, cannot have any Power of attraction or depulſion in them. According to that common Principle, *Quantitatis nulla eſt efficacia.*

A magnetical Natural Attraction. So *Keplar, Somn. Aſtron. N.* 66. *Coper. l.* 1. *cap.* 26. *Foſcarin in epiſt. ad Sebaſt. Fantonum.*

But now the true nature of Gravity is this. 'Tis ſuch a reſpective mutual deſire of union, whereby condenſed Bodies, when they come within the Sphere of their own Vigour, do naturally apply themſelves one to another by attraction or coition. But being both without the reach of either's Virtue, they then ceaſe to move, and though they have general aptitude, yet they have not any preſent inclination or proneneſs to one another. And ſo conſequently cannot be ſtyl'd heavy.

The meaning of this will be more clearly illuſtrated by a Similitude. As any light Body (ſuppoſe the Sun) does ſend forth its Beams in an Orbicular Form; ſo likewiſe any Magnetical Body, for inſtance a Round Loadſtone does caſt abroad his Magnetical Vigour in a Sphere. Thus.

Gilbert. de Magnet. l. 2. *cap.* 7.



Where ſuppoſe the inward Circle at *A* to repreſent the Loadſtone, and the outward one betwixt *B*, *C*, the Orb that does determinate its Virtue.

Now

Now any other Body that is like affected coming within this Sphere, as *B*, will presently descend towards the Center of it, and in that respect may be styled heavy. But place it without this Sphere as *C*, and then the desire of union ceaseth, and so consequently the Motion also.

To apply then what hath been said. This great Globe of Earth and Water hath been proved by many Observations, to participate of Magnetical Properties. And as the Loadstone does cast forth its own Vigour round about its Body, in a Magnetical Compass, so likewise does our Earth. The difference is, that it is another kind of Affection which causes the Union betwixt the Iron and Loadstone, from that which makes Bodies move unto the Earth. The former is some kind of nearness and similitude in their Natures, for which Philosophy, as yet, has not found a particular Name. The latter does arise from that peculiar Quality whereby the Earth is properly distinguish'd from the other Elements, which is its Condensity. Of which the more any thing does participate, by so much the stronger will be the desire of union to it. So Gold and other Metals which are most close in their Composition, are likewise most swift in their Motion of Descent.

And though this may seem to be contradicted by the instance of Metals which are of the same weight, when they are melted, and when they are hard: As also of Water, which does not differ in respect of Gravity, when it is frozen, and when it is fluid: Yet we must know that Metals are not rarify'd by melting, but mollify'd. And so too for Frozen Waters, they are not properly condensed, but congealed into a harder Substance, the Parts being not contracted closer together, but still possessing the same Extension. But yet (I say) 'tis very probable that there is such a Sphere about the Earth, which does terminate its Power of attracting other things unto it. So that suppose

a Body

a Body to be placed within the Limits of this Sphere, and then it must needs tend downwards towards the Center of it. But on the contrary, if it be beyond this Compass, then there can be no such mutual attraction; and so consequently it must rest immovable from any such Motion.

For the farther confirmation of this, I shall propose two Pertinent Observations.

Lib. de Sympath. & Antip. c. 7.

The first taken in the presence of many Physicians, and related by an Eminent Man in that Profession, *Hieron. Fracastorius.* There being divers Needles provided of several kinds, like those in a Mariner's Chart; they found that there was an attractive Power not only in the Magnet, but that Iron also, and Steel, and Silver did each of them draw its own Metal. Whence he concludes, *Omne trahit quod sibi simile est.* And as these peculiar Likenesses have such a mutual efficacy, so 'tis probable that this more general Qualification of Condensity may be the cause why things so affected desire union to the Earth. And though 'tis likely that this would appear betwixt two lesser Condensed Bodies, (as suppose two Pieces of Earth) if they were both placed at liberty in the Æthereal Air, yet being near the Earth, the stronger Species of this great Globe does, as it were, drown the less.

Vid. Bapt. Mas. exer. Acad. de attract. exer. 4.

'Tis a common Experiment, that such a Lump of Ore or Stone, as being on the Ground, cannot be moved by less than Six Men, being in the bottom of a deep Mine, may be stirred by two. The Reason is, because then 'tis compassed with attractive Beams, there being many above it as well as below it. Whence we may probably infer (saith the Learned *Verulam*), "That the Nature of Gravity does work but "weakly also far from the Earth; because the Appe-"tite of Union in Dense Bodies must be more dull in "respect of distance." As we may also conclude from the Motion of Birds, which rise from the Ground but heavily, though with much Labour; whereas be-

Nat. Hist. Cent. 1. exper. 33.

ing

ing on high, they can keep themſelves up, and ſoar about by the meer extenſion of their Wings. Now the Reaſon of this difference, is not (as ſome falſly conceive) the depth of Air under them. For a Bird is not heavier when there is but a Foot of Air under him, than when there is a Furlong. As appears by a Ship in the Water, (an Inſtance of the ſame nature) which does not ſink deeper, and ſo conſequently is not heavier, when it has but five Fathom depth, than when it has fifty. But the true Reaſon is, the weakneſs of the Deſire of Union in Denſe Bodies at a diſtance.

So that from hence, there might be juſt occaſion to tax *Ariſtotle* and his Followers, for teaching that Heavineſs is an abſolute Quality of it ſelf, and really diſtinct from Condenſity: Whereas it is only a Modification of it, or rather another Name given to a condenſed Body in reference to its Motion.

For if it were abſolute, then it ſhould always be inherent in its Subject, and not have its Eſſence depend upon the Bodies being here or there. But it is not ſo. For,

1. Nothing is heavy in its proper Place, according to his own Principle, *Nihil grave eſt in ſuo loco.* And then,

2. Nothing is heavy, which is ſo far diſtant from that proper Orb to which it does belong, that it is not within the reach of its Virtue. As was before confirmed.

But unto this it may be objected; though a Body being ſo placed, be not heavy *in actu ſecundo*; yet it is *in actu primo*: Becauſe it retains in it an inward Proneneſs to move downwards, being once ſevered from its proper Place. And this were Reaſon enough why the Quality of Heavineſs ſhould have an abſolute Being.

I anſwer, this Diſtinction is only appliable to ſuch natural Powers as can ſuſpend their Acts; and will not

not hold in Elementary Qualities, whoſe very Eſſence does neceſſarily require an Exerciſe of the ſecond Act, as you may eaſily diſcern by an Induction of all the reſt. I cannot ſay, that Body has in it the Quality of Heat, Coldneſs, Drineſs, Moiſture, Hardneſs, Softneſs, *&c.* which for the preſent has not the ſecond Act of theſe Qualities. And if you mean by the Eſſence of them, a Power unto them: Why, there is not any natural Body but has a Power to them all.

From that which hath been ſaid concerning the Nature of Gravity, it will follow, That if a Man were above the Sphere of this Magnetical Virtue which proceeds from the Earth, he might there ſtand as firmly in the open Air, as he can now upon the Ground: And not only ſo, but he may alſo move with a far greater Swiftneſs, than any living Creatures here below; becauſe then he is without all Gravity, being not attracted any way; and ſo conſequently will not be liable to ſuch Impediments as may in the leaſt manner reſiſt that kind of Motion which he ſhall apply himſelf unto.

If you yet enquire, how we may conceive it poſſible, that a condenſed Body ſhould not be heavy in ſuch a Place?

I anſwer, by the ſame Reaſon as a Body is not heavy in its proper Place. Of this I will ſet down two Inſtances.

1. When a Man is in the Bottom of a deep River, though he have over him a Multitude of heavy Waters, yet he is not burden'd with the Weight of them. And though another Body, that ſhould be but of an equal Gravity with theſe Waters, when they are taken out, would be heavy enough to preſs him to Death; yet notwithſtanding whilſt they are in the Channel, they do not in the leaſt manner cruſh him with their Load. The Reaſon is, becauſe they are both in their right Places; and 'tis proper for the Man, being the

more

more condenſed Body, to be lower than the Waters. Or rather thus, Becauſe the Body of the Man does more nearly agree with the Earth, in this Affection, which is the Ground of its Attraction, and therefore doththat more ſtrongly attract it, than the Waters that are over it. Now, as in ſuch a Caſe, a Body may loſe the Operation of its Gravity, which is, to move, or to preſs downwards: So may it likewiſe, when it is ſo far out of its Place, that this attractive Power cannot reach unto it.

'Tis a pretty Notion to this Purpoſe, mentioned by * *Albertus de Saxonia*, and out of him by † *Francis Mendoca*; That the Air is in ſome part of it Navigable. And that upon this Statick Principle, any Braſs or Iron Veſſel (ſuppoſe a Kettle) whoſe Subſtance is much heavier than that of the Water; yet being filled with the lighter Air, it will ſwim upon it, and not ſink. So ſuppoſe a Cup, or Wooden Veſſel, upon the outward Borders of this Elementary Air, the Cavity of it being filled with Fire, or rather Æthereal Air, it muſt neceſſarily upon the ſame Ground remain ſwimming there, and of it ſelf can no more fall, than an empty Ship can ſink.

* *Phyſ. l.* 3. *Q. art.* 2. 6.
† *Viridar. l.* 4. *prob.* 47. *Vid. Arch. l. de inſidentibus humido.*

2. 'Tis commonly granted, that if there were a Hole quite through the Centre of the Earth, though any heavy Body (as ſuppoſe a Milſtone) were let fall into it; yet when it came unto the Place of the Centre, it would there reſt immoveable in the Air. Now, as in this Caſe, its own Condenſity cannot hinder, but that it may reſt in the open Air, when there is no other Place to which it ſhould be attracted; ſo neither could it be any Impediment unto it, if it were placed without the Sphere of the Earth's Magnetical Vigor, where there ſhould be no Attraction at all.

From hence then (I ſay) you may conceive, that if a Man were beyond this Sphere, he might there ſtand as firmly in the open Air, as now upon the Earth. And if he might ſtand there, why might he

not alſo go there? And if ſo; then there is a Poſſibility likewiſe of having other Conveniences for Travelling.

And here 'tis conſiderable, that ſince our Bodies will then be devoid of Gravity, and other Impediments of Motion; we ſhall not at all ſpend our ſelves in any Labour, and ſo conſequently not much need the Reparation of Diet: But may perhaps live altogether without it, as thoſe Creatures have done, who by reaſon of their Sleeping for many Days together, have not ſpent any Spirits, and ſo not wanted any Food: Which is commonly related of Serpents, Crocodiles, Bears, Cuckoes, Swallows, and ſuch like. To this purpoſe, * *Mendoca* reckons up divers ſtrange Relations. As that of *Epimenides*, who is ſtoried to have ſlept 75 Years. And another of a Ruſtick in *Germany*, who being accidentally covered with a Hay-rick ſlept there for all Autumn, and the Winter following, without any Nouriſhment.

* *Viridar. l. 4. prob. 24.*

Or, if this will not ſerve; yet why may not a Papiſt faſt ſo long, as well as *Ignatius* or *Xaverius*? Or if there be ſuch a ſtrange Efficacy in the Bread of the Euchariſt, as their miraculous Relations do attribute to it: Why then, that may ſerve well enough, for their *Viaticum*.

Or, if we muſt needs feed upon ſomething elſe, why may not Smells nouriſh us? * *Plutarch* and † *Pliny* and divers other Ancients, tell us of a Nation in *India* that lived only upon pleaſing Odors. And 'tis the common Opinion of Phyſicians, that theſe do ſtrangely both ſtrengthen and repair the Spirits. Hence was it that *Democritus* was able for divers Days together, to feed himſelf with the meer Smell of hot Bread.

* *De facie in Luna.*
† *Nat. Hiſt. l. 7. c. 2.*
Diog. Laer. l. 1. c. 9.

Or if it be neceſſary that our Stomachs muſt receive the Food: Why then 'tis not impoſſible that the Purity of the Æthereal Air, being not mixed with any improper Vapours, may be ſo agreeable to our Bodies, as

as to yield us ſufficient Nonriſhment; acoording to that of the Poet:

——— ——— *Veſcitur aurâ* *Virgil.*
Ætherea ——— ——— ———

'Twas an old *Platonick* Principle, that there is in ſome part of the World ſuch a Place where Men might be plentifully nouriſhed by the Air they breathe: Which cannot more properly be aſſigned to any one particular, than to the Æthereal Air above this.

I know 'tis the common Opinion, that no *Element* can prove *Aliment*, becauſe 'tis not proportionate to the Bodies of living Creatures which are compounded. But, *Ariſt. de Senſ. c. 5.*

1. This Æthereal Air is not an Element; and tho' it be purer, yet 'tis perhaps of a greater Agreeableneſs to Man's Nature and Conſtitution.

2. If we conſult Experience and the credible Relations of others, we ſhall find it probable enough that many things receive Nouriſhment from meet Elements.

Firſt, for the Earth; * *Ariſtotle* and † *Pliny*, thoſe two great Naturaliſts, tell us of ſome Creatures, that are fed only with this. And it was the Curſe of the Serpent, *Gen.* 3. 14. *Upon thy belly ſhalt thou go, and duſt ſhalt thou eat all the days of thy life.* The earth.

So likewiſe for the Water. ∴ *Albertus Magnus* ſpeaks of a Man who lived Seven Weeks together by the meer Drinking of Water. * *Rondoletius* (to whoſe Diligence theſe later Times are much beholden for ſundry Obſervations concerning the Nature of Aquatils;) affirms that his Wife did keep a Fiſh in a Glaſs of Water, without any other Food for three Years: In which Space it was conſtantly augmented, till at firſt it could not come out of the Place at which it was put in, and at length was too big for the Glaſs it ſelf, though that were of a large Capacity. *Cardan* tells us of ſome Worms, that are bred and nouriſhed by the Snow, from which being once ſeparated, they die. *Subtil. l. 9.*

* *Hiſt. Animal. l.* 8. *cap.* 5.
† *Hiſt. l.* 10. *cap.* 72.
The Water.
∴ *De Animal. l.* 7.
* *De Piſc. l.* 1. *c.* 12.

The Air. Thus alſo is it with the Air, which we may well conceive does chiefly concur to the nouriſhing of all Vegetables. For if their Food were all ſucked out from the Earth, there muſt needs be then ſome ſenſible Decay in the Ground by them; eſpecially ſince they do every Year renew their Leaves and Fruits: Which being ſo many, and ſo often, could not be produced without Abundance of Nouriſhment. To this purpoſe is the Experiment of Trees cut down which will of themſelves put forth Sprouts. As alſo that of Onions, and the Semper-vive, which will ſtrangely ſhoot forth, and grow as they hang in the open Air. Thus likewiſe is it with ſome ſenſible Creatures; the *Camelion* (ſaith * *Pliny* and † *Solinus*) meerly nouriſhed by this: And ſo are the Birds of Paradiſe, treated of by many .·., which reſide conſtantly in the Air, Nature having not beſtowed upon them any Legs, and therefore they are never ſeen upon the Ground but being dead. If you ask how they multiply? 'Tis anſwered, they lay their Eggs on the Backs of one another, upon which they ſit till their young Ones be fledg'd. * *Rhondoletius* from the Hiſtory of *Hermolaus Barbarus*, tells us of a Prieſt (of whom one of the Popes had the Cuſtody) that lived Forty Years upon meer Air. As alſo of a Maid in *France*, and another in *Germany*, that for divers Years together did feed on nothing but this: Nay, he affirms that he himſelf had ſeen one, who lived till ten Years of Age without any other Nouriſhment. You may find moſt of theſe, and ſome other Examples to this purpoſe, gathered together by *Mendoca Viridar. Lib.* 4. *Prob.* 23, 24. Now, if this Elementary Air, which is mixed with ſuch improper Vapours, may accidentally nouriſh ſome Perſons; perhaps then, that pure Æthereal Air may of it ſelf be more natural to our Tempers.

But if none of theſe Conjectures may ſatisfy; yet there may haply be ſome poſſible Means for the Conveyance of other Food, as ſhall be ſhewed afterwards.

Again,

* *Hiſt. l.* 8. *cap.* 33. *Polyhiſtor. cap.* 53.

† *Lop. hiſt. Ind. Occid. cap.* 96. *Maiolus. Colloq.* 3.

.·. 'Tis likely that theſe Birds do chiefly reſide in the Æthereal Air, wher they are nouriſhed and upheld.

* *De Piſcibus, l.* 1. *cap.* 13.

Again, ſeeing we do not then ſpend our ſelves in any Labour, we ſhall not, it may be, need the Refreſhment of Sleep. But if we do, we cannot deſire a ſofter Bed than the Air, where we may repoſe our ſelves firmly and ſafely as in our Chambers.

But here you may ask, whether there be any means for us to know, how far this Sphere of the Earth's Virtue does extend it ſelf?

I anſwer, 'tis probable that it does not reach much farther than that Orb of thick vaporous Air, that encompaſſeth the Earth; becauſe 'tis likely the Sun may exhale ſome earthly Vapours, near unto the utmoſt Bounds of the Sphere allotted to them.

Now there are divers ways uſed by Aſtronomers, to take the Altitude of this vaporous Air. As,

1. By obſerving the Height of that Air which cauſeth the *Crepuſculum*, or Twilight; for the finding of which, the Ancients uſed this Means: As ſoon as ever they could diſcern the Air in the *Eaſt* to be altered with the leaſt Light, they would by the Situation of the Stars find out how many Degrees the Sun was below the *Horizon*, which was uſually about Eighteen. From whence they would eaſily conclude, how high that Air muſt be above us, which the Sun could ſhine upon, when he was 18 Degrees below us. And from this Obſervation, it was concluded to be about 52 Miles high. *Vitel. l.* 10. *Theo.* 7.

But in this Concluſion, the Ancients were much deceived, becauſe they proceeded upon a wrong ground, whilſt they ſuppoſed that the Shining of the Sun's direct Rays upon the Air, was the only Reaſon of the *Crepuſculum*; whereas 'tis certain that there are many other things which may alſo concur to the cauſing of it. As, *Keplar. Ep. Coper. l.* 1. *part* 3.

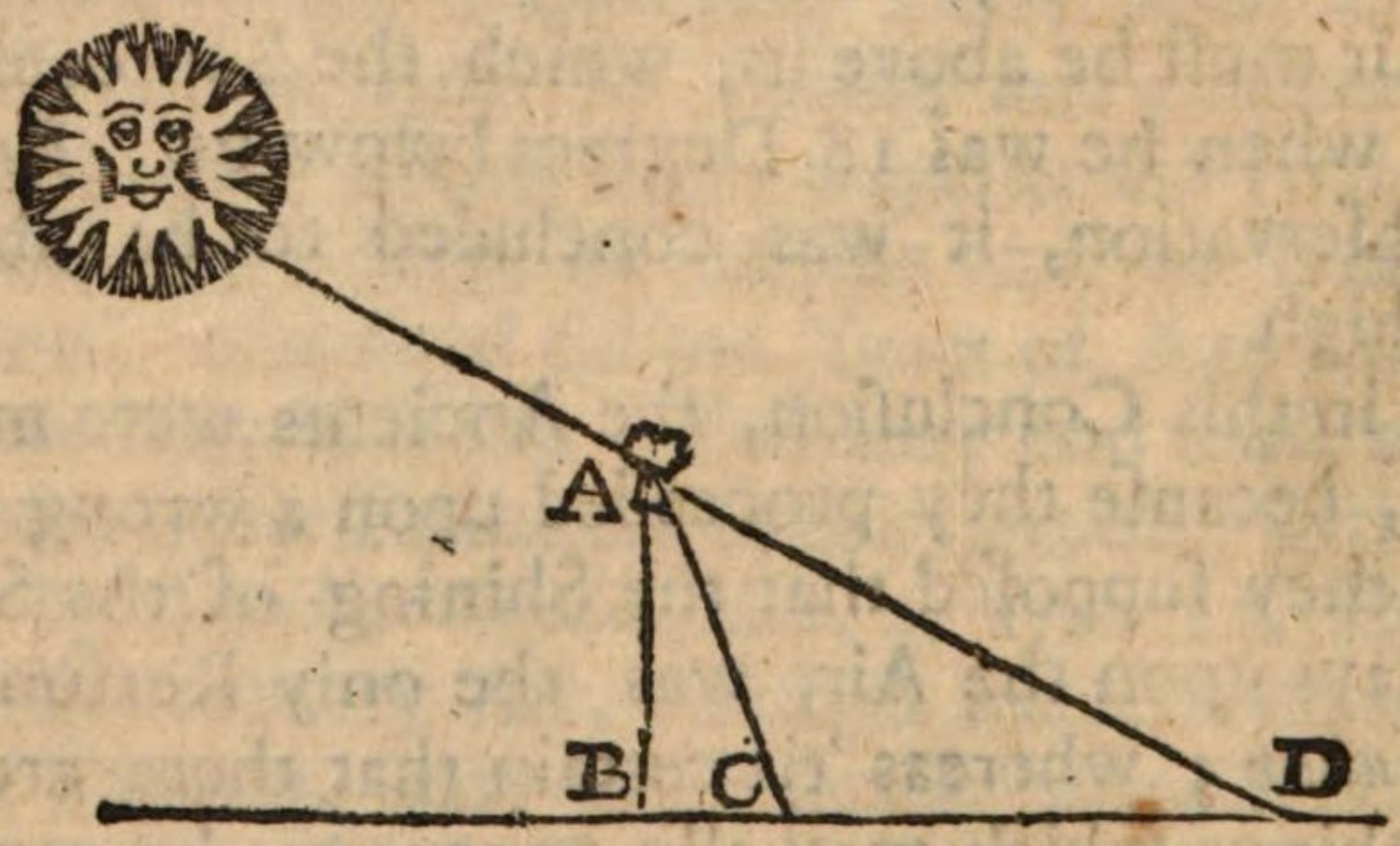
1. Some bright Clouds below the *Horizon*, which being illuminated by the Sun, may be the Means of conveying ſome Light to our Air, before the direct Rays can touch it.

2. The often Refraction of the Rays, which ſuffer a frequent Repercuſſion from the Cavity of this Sphere, may likewiſe yield us ſome Light.

3. And ſo may the Orb of enlightned Air compaſſing the Sun, part of which muſt riſe before his Body.

2. The ſecond way whereby we may more ſurely find the Altitude of this groſſer Air, is by taking the Heighth of the higheſt Cloud: Which may be done, 1. Either as they uſe to meaſure the Altitude of things that cannot be approached unto, *viz.* by two Stations, when two Perſons ſhall at the ſame time, in ſeveral Places, obſerve the Declination of any Cloud from the vertical Point. Or, 2. which is the more eaſie way, when a Man ſhall chuſe ſuch a Station, where he may at ſome diſtance diſcern the Place on which the Cloud does caſt its Shadow, and withal does obſerve, how much both the Cloud and the Sun decline from the vertical Point. From which he may eaſily conclude the true Altitude of it, as you may more plainly conceive by this following Diagram.

Stevinius. Geog. l. 3. *prop.* 3.



Where *A B* is a perpindicular from the Cloud, *C* the Station of him that meaſures, *D* the Place where the Shadow of the Cloud doesfall.

The

The Instrument being directed from the Station *C*, to the Cloud at *A*, the Perpendicular will shew the Angle *B A C*. Then letting the Sun shine through the Sights of your Instrument, the Perpendicular of it will give the Angle *B A D*. Afterwards having measured the Distance *C D* by Paces, you may according to the common Rules, find the Heighth *B A*. *Pitisc. Trigon.*

But if without making the Observation, you would know of what Altitude the highest of these are found by Observation; * *Cardan* answers, not above two Miles; † *Keplar* not above 16000 Paces or thereabouts. **Subt. l. 17.* *† Epit. Cop. l. 1. p. 3.*

3. Another way to find the Height of this vaporous Air, is, by knowing the Difference of Altitude which it causeth in refracting the Beams of any Star near the *Horizon*. And from this Observation also, it is usually concluded to be about two or three Miles high.

But now you must not conceive, as if the Orb of Magnetical Vigor were bounded in an exact Superficies, or as if it did equally hold out just to such a determinate Line, and no farther. But, as it hath been said of the first Region, which is there terminated where the Heat of Reflexion does begin to languish; so likewise is it probable, that this Magnetical Vigor does remit of its Degrees proportionally to its Distance from the Earth, which is the Cause of it: And therefore though the thicker Clouds may be elevated no higher, yet this Orb may be continued in weaker Degrees a little beyond them. We will suppose it (which in all likelihood is the most) to be about twenty Miles high. So that you see the former Thesis remains probable; that if a Man could but fly, or by any other Means get twenty Miles upwards, it were possible for him to reach unto the Moon.

But it may be again objected; Though all this were true; though there were such an Orb of Air which did terminate the Earth's Vigor: And though the Heavinesse of our Bodies could not hinder our Pas-

ſage through the vaſt Spaces of the Æthereal Air; yet thoſe two other Impediments may ſeem to deny the Poſſibility of any ſuch Voyage.

1. The extream *Coldneſs* of that Air. If ſome of our higher Mountains for this reaſon be not habitable, much more then will thoſe Places be ſo, which are farther from any cauſe of Heat.

2. The extream thinneſs of it, which may make it unfit for Expiration. For, if in ſome Mountains (as *Ariſtotle* tells us of *Olympus*, and out of him * St. *Auſtin*) the Air be ſo thin, that Men cannot draw their Breath, unleſs it were through ſome moiſtned Spunges; much more then muſt that Air be thin, which is more remotely ſituated from the Cauſes of Impurity and Mixture. And then beſide, the Refraction that is made by the vaporous Air encompaſſing our Earth, may ſufficiently prove that there is a great difference betwixt the Æthereal Air and this, in reſpect of Rarity.

* *In Gen. ad literam. l. 3. cap. 2.*

To the firſt of theſe I anſwer, That though the ſecond Region be naturally endowed with ſo much Coldneſs, as may make it fit for the production of Meteors; yet it will not hence follow, that all that Air above it which is not appointed for the like purpoſe, ſhould partake of the ſame Condition: But it may ſeem more probable, that this Æthereal Air is freed from having any Quality in the Extreams. And this may be confirmed from thoſe common Arguments, which are uſually brought to prove the Warmneſs of the third Region; as you may ſee in * *Fromundus*, and others who treat of that Subject.

* *Meteor. lib. 1. ca. 2. art. 1.*

'Tis the Aſſertion of *Pererius*, that the ſecond Region is not cold meerly for this Reaſon, becauſe it is diſtant from the ordinary Cauſes of Heat, but becauſe it was actually made ſo at the firſt, for the condenſing of the Clouds, and the production of other Meteors that were there to be generated; which (as I conceive) might be ſufficiently confirmed from that

Comment. in Gen. 1. 8.

Order

Order of the Creation obſerved by *Moſes*, who tells us that the Waters above the Firmament (by which, in the greateſt probability, we are to underſtand the Clouds in the ſecond Region) were made the ſecond Day, *Gen.* 1. 7, 8. whereas the Sun it ſelf (whoſe Reflection is the cauſe of Heat) was not created till the fourth Day, *ver.* 16, 19.

To the other Objection I anſwer, That though the Air in the ſecond Region (where by reaſon of its Coldneſs there are many thick Vapours) do cauſe a great Refraction; yet 'tis probable that the Air which is next the Earth, is ſometimes, and in ſome places, of a far greater thinneſs; nay, as thin as the Æthereal Air it ſelf; ſince ſometimes there is ſuch a ſpecial heat of the Sun, as may rarifie it in an eminent degree: And in ſome dry places, there are no groſs impure Exhalations to mix with it.

But here it may be objected: If the Air in the ſecond Region were more condenſed and heavy than this wherein we breathe, then that muſt neceſſarily tend downwards, and poſſeſs the lower place.

To this ſome anſwer, That the hanging of the Clouds in the open Air, is no leſs than a Miracle. They are the words of *Pliny*: *Quid mirabilius aquis in cælo ſtantibus*? What more wonderful thing is there, than that the Waters ſhould ſtand in the Heavens? *Hiſt. l. 31. cap. 1.*

Others prove this from the Derivation of the word שמים from שאה *ſtupeſcere* and מים *aquæ*; becauſe the Waters do hang there after ſuch a ſtupendious inconceivable Manner: Which ſeems likewiſe to be favoured by Scripture, where 'tis mentioned as a great Argument of God's Omnipotency, that he holds up the Clouds from falling. *He binds up the Waters in his thick Clouds, and the Cloud is not rent under them.* *Job* 26. 8.

But that which unto me ſeems full Satisfaction againſt this Doubt, is this Conſideration; That the natural Vigour whereby the Earth does attract denſe Bodies unto it, is leſs efficacious at a diſtance; and there-

therefore a Body of leſs Denſity, which is near unto it, as ſuppoſe this thin Air wherein we breathe, may naturally be lower in its Situation, than another of a greater Condenſity that is farther off; as ſuppoſe the Clouds in the ſecond Region. And though the one be abſolutely, and in it ſelf more fit for this Motion of Deſcent; yet by reaſon of its diſtance, the Earth's Magnetical Vertue cannot ſo powerfully work upon it.

As for that Relation of *Ariſtotle*, if it were true, yet it does not prove this Air to be altogether impaſſible, ſince moiſtned Spunges might help us againſt its thinneſs: But 'tis more likely that he took it upon truſt, as he did ſome other Relations concerning the height of the Mountains, wherein 'tis evident that he was groſly miſtaken: As where he tells us of *Caucaſus*, that it caſts its Shadow 560 Miles. And this Relation being of the ſame Nature, we cannot ſafely truſt unto him for the truth of it.

Meteor. l. 1. c. 11.

If it be here enquired, what Means there may be conjectured, for our aſcending beyond the Sphere of the Earth's Magnetical Vigour.

I anſwer. 1. 'Tis not perhaps impoſſible that a Man may be able to Fly, by the application of Wings to his own Body: As Angels are pictured, as *Mercury* and *Dædalus* are feigned, and as hath been attempted by divers; particularly by a *Turk* in *Conſtantinople*, as *Busbequius* relates.

Mr. Burton. Melanch. *pa. 2. ſect. 2. mem. 3.*

2. If there be ſuch a great *Ruck* in *Madagaſcar*, as * *Marcus Polus* the *Venetian* mentions, the Feathers in whoſe Wings are twelve Foot long, which can ſoop up a Horſe and his Rider, or an Elephant, as our Kites do a Mouſe; why then 'tis but teaching one of theſe to carry a Man, and he may ride up thither, as *Ganymede* does upon an Eagle.

* *Lib. 3. c. 40.*

3. Or if neither of theſe Ways will ſerve: Yet I do ſeriouſly, and upon good Grounds affirm it poſſible to make a Flying-Chariot; in which a Man may ſit,

ſit, and give ſuch a Motion unto it, as ſhall convey him through the Air. And this perhaps might be made large enough to carry divers Men at the ſame time, together with Food for their *Viaticum*, and Commodities for Traffick. It is not the bigneſs of any thing in this kind, that can hinder its Motion, if the motive Faculty be anſwerable thereunto. We ſee a great Ship ſwims as well as a ſmall Cork, and an Eagle flies in the Air as well as a little Gnat.

This Engine may be contrived from the ſame Principles by which *Archytas* made a Wooden Dove, and *Regiomontanus* a Wooden Eagle.

I conceive it were no difficult Matter (if a Man had leiſure) to ſhew more particularly the Means of Compoſing it.

The perfecting of ſuch an Invention, would be of ſuch excellent Uſe, that it were enough, not only to make a Man Famous, but the Age alſo wherein he lives. For beſides the ſtrange Diſcoveries that it might occaſion in this other World, it would be alſo of inconceivable Advantage for Travelling, above any other Conveyance that is now in uſe.

So that notwithſtanding all theſe ſeeming Impoſſibilities, 'tis likely enough, that there may be a Means invented of Journying to the Moon; and how happy ſhall they be, that are firſt ſucceſsful in this Attempt?

——— *Feliceſq; animæ, quas nubila ſupra,*
Et turpes fumos, plenumq; vaporibus orbem,
Inſeruit cælo ſancti ſcintilla Promethei.

Having thus finiſhed this Diſcourſe, I chanced upon a late Fancy to this purpoſe, under the feigned Name of *Domingo Gonſales*, written by a late Reverend and Learned Biſhop: In which (beſides ſundry Particulars wherein this latter Chapter did unwittingly agree with it) there is delivered a very pleaſant and

and well-contrived Fancy concerning a Voyage to this other World.

He ſuppoſeth that there is a natural and uſual Paſſage for many Creatures betwixt our Earth and this Planet. Thus he ſays, thoſe great Multitudes of Locuſts, wherewith divers Countries have been deſtroyed, do proceed from thence. And if we peruſe the Authors who treat of them, we ſhall find that many times they fly in numberleſs Troops, or Swarms, and for ſundry Days together before they fall, are ſeen over thoſe Places in great high Clouds, ſuch as coming nearer, are of extenſion enough to obſcure the Day, and hinder the Light of the Sun. From which, together with divers other ſuch Relations, he concludes that 'tis not altogether improbable they ſhould proceed from the Moon. Thus likewiſe he ſuppoſeth the Swallows, Cuckoes, Nightingales, with divers other Fowl, which are with us only half the Year, to fly up thither, when they go from us. Amongſt which kind, there is a Wild-Swan in the *Eaſt-Indies*, which at certain Seaſons of the Year do conſtantly take their Flight thither. Now this Bird being of great ſtrength, able to continue for a long Flight, as alſo going uſually in Flocks, like our Wild-Geeſe; he ſuppoſeth that many of them together, might be taught to carry the weight of a Man; eſpecially if an Engine were ſo contrived (as he thinks it might) that each of them ſhould bear an equal ſhare in the Burden. So that by this means 'tis eaſily conceivable, how once every Year a Man might finiſh ſuch a Voyage; going along with theſe Birds at the beginning of Winter, and again returning with them at the Spring.

And here, one that had a ſtrong Fancy, were better able to ſet forth the great Benefit and Pleaſure to be had by ſuch a Journey. And that whether you conſider the ſtrangeneſs of the Perſons, Language,

Arts,

Arts, Policy, Religion of thoſe Inhabitants, together with the new Traffick that might be brought thence. In brief, do but conſider the Pleaſure and Profit of thoſe later Diſcoveries in *America*, and we muſt needs conclude this to be inconceivably beyond it.

But ſuch Imaginations as theſe, I ſhall leave to the Fancy of the Reader.

——— ——— *Sic itur ad aſtra.*
Reptet humi quicunq; velit ——— ———

Cælo reſtat iter, cælo tentabimus ire.

THE

The SECOND BOOK.

A

DISCOURSE

Concerning A

NEW PLANET.

Tending to prove, *That* ('tis probable) *our Earth is one of the* Planets.

Digna res eſt Contemplatione, ut ſciamus in quo rerum ſtatu ſcimus: Pigerimam ſortiti, an velociſſimam ſedem: Circa nos Deus omnia, an nos agat. Sen. Nat. Quæſt. Lib. 7. Cap. 2.

The Fifth Impreſſion.

By the Right Reverend Father in God, *JOHN WILKINS*, late Lord Biſhop of *CHESTER*.

LONDON:

Printed for *John Nicholſon* at the *King's-Arms* in *Little Britain*; *Benj. Tooke* at the *Middle Temple Gate* in *Fleetſtreet*; *And. Bell* at the *Croſs Keys and Bible* in *Cornhill*; and *Ralph Smith* under the *Piazza* of the *Royal-Exchange*. MDCCVII.

THE SECOND BOOK.

DISCOURSE

Concerning

NEW PLANET.

Teaching to prove, That (if probable)
our Earth is only of the Planets.

To the READER.

NOT to trouble you with an *Invective* againſt thoſe multitudes of Pamphlets which are every Day preſs'd into the World; or an *Apology*, why this was publiſh'd amongſt the reſt (the uſual Matter for ſuch kind of Epiſtles:) Let me in brief premoniſh you ſomething concerning the

Chief Scope
And
Manner
} of this following Diſcourſe.

1. 'Tis not the *Purpoſe* of it to ſet down an Exact Treatiſe of this kind of *Aſtronomy*, but rather to remove thoſe Common Prejudices which uſually deter Men from taking any Argument, tending this way, into their Conſiderations. For we may obſerve, that in thoſe Points which are cry'd down by the more General Opinion, Men do for the moſt part reſt themſelves in the Superficial Knowledge of Things, as they ſeem at their firſt Appearances, thinking they can ſay enough to any Paradox, againſt which they can urge the moſt Obvious and Eaſy Objections; and therefore ſeldom or never ſearch into the depth of theſe Points, or enter into any Serious Impartial Examination of thoſe Grounds on which they are bottomed. Which as it muſt needs be a great hindrance to the Proficiency of all kind of Learning, ſo more eſpecially is it in this Particular. We might diſcern a greater Comelineſs and Order in this great Fabrick of the World, and more eaſily underſtand the Appearances in *Aſtronomy*, if we could with Indifferency attend to what might be ſaid for that Opinion of *Copernicus*, which is here defended.

2. *For the Manner.* It is not maintained with such Heat and Religion, as if every one that reads it were presently bound to yield up his Assent: But as it is in other Wars where *Victory* cannot be had, Men must be content with Peace: So likewise is it in this, and should be in all other Philosophical Contentions. If there be nothing able to convince and satisfy the Indifferent Reader, he may still enjoy his own Opinion. All Men have not the same way of apprehending things; but according to the Variety of their Temper, Custom, and Abilities, their Understandings are severally fashioned to different Assents: Which had it been but well consider'd by some of our Hot * Adversaries, they would not have shewed more *Violence* in opposing the *Persons* against whom they write, than *Strength* in confuting the *Cause*.

* *Fromond. Al. Ross.*

'Tis an Excellent Rule to be observed in all Disputes, That Men should give *Soft Words* and *Hard Arguments*; that they would not so much strive to *vex*, as to *convince* an Enemy. If this were but diligently practised in all Cases, and on all sides, we might in a good measure be freed from those Vexations in the search of Truth, which the Wise *Solomon*, by his own Experience did so much complain of, *Ecclesiastes* 1. 18. *In much Wisdom there is much Grief; and he that increaseth Knowledge, increaseth Sorrow.*

To conclude: Though there should be nothing in this Discourse conducible to your Information and Benefit; yet it may serve in the *Perusal*, as it did in the *Composure*, for the Recreation of such Leisure Hours as may conveniently be spared from more weighty Employments.

Farewell.

THE

THE PROPOSITIONS That are insisted on in this DISCOURSE.

PROP. I.

THAT the seeming Novelty and Singularity of this Opinion can be no sufficient Reason to prove it erroneous.

PROP. II.

That the Places of Scripture which seem to intimate the Diurnal Motion of the Sun or Heavens, are fairly capable of another Interpretation.

PROP. III.

That the Holy Ghost in many Places of Scripture does plainly conform his Expressions to the Error of our Conceits, and does not speak of sundry Things as they are in themselves, but as they appear unto us.

PROP. IV.

That divers Learned Men have fallen into great Absurdities, whilst they have looked for the Grounds of Philosophy from the Words of Scripture.

PROP. V.

That the Words of Scripture in their Proper and Strict Construction, do not any where affirm the Immobility of the Earth.

PROP. VI.

That there is not any Argument from the Words of Scripture, Principles of Nature, or Observations in Astronomy, *which can sufficiently evidence the Earth to be in the Center of the Universe.*

PROP. VII.

'Tis probable that the Sun is in the Centre of the World.

PROP. VIII.

That there is not any sufficient Reason to prove the Earth incapable of those Motions which Copernicus *ascribes unto it.*

PROP. IX.

That it is more probable the Earth does move, than the Heavens.

PROP. X.

That this Hypothesis *is exactly agreeable to Common Appearances.*

THAT

That the Earth may be a Planet.

PROP. I.

That the Seeming Novelty and Singularity of this Opinion, can be no Sufficient Reason to prove it erroneous.

IN the search of Theological Truths, it is the safest Method, first of all to look unto Divine Authority; because that carries with it as clear an Evidence to our Faith, as any thing else can be to our Reason. But on the contrary, in the examination of Philosophical Points, it were a preposterous Course to begin at the Testimony and Opinion of others, and then afterwards to descend unto the Reasons that may be drawn from the Nature and Essence of the things themselves: Because these Inartificial Arguments (as the Logicians call them) do not carry with them any clear and convincing Evidence; and therefore should come after those that are of more necessary dependance, as serving rather to confirm, than resolve the Judgment.

But yet, so it is, that in those Points which are besides the Common Opinion, Men are carried away at the first by the general Cry, and seldom or never come so far, as to examine the Reasons that may be urged for them. And therefore, since it is the Purpose of this Discourse, to remove those Prejudices which may hinder our Judgment in the like Case, 'tis requisite that in the first place there be some satisfacti-

on given to thoſe Arguments that may be taken from the Authority of others.

Which Arguments are inſiſted on by our Adverſaries with much Heat and Violence.

What (ſay they) ſhall an upſtart Novelty thruſt out ſuch a Truth as hath paſſed by Succeſſive Tradition through all Ages of the World; and hath been generally entertain'd, not only in the Opinion of the Vulgar, but alſo of the greateſt Philoſophers, and moſt Learned Men? * Shall we think that amongſt the multitude of thoſe who in ſeveral Times have been eminent for New Inventions, and Strange Diſcoveries, there was none able to find out ſuch a Secret as this, beſides ſome Fabulous *Pythagoreans*, and of late *Copernicus*? Is it probable that the World ſhould laſt for above Five Thouſand Years together, and yet the Inhabitants of it be ſo dull and ſtupid, as to be unacquainted with its Motion? Nay, ſhall we think that thoſe Excellent Men whom the Holy Ghoſt made uſe of in the Penning of Scripture, who were extraordinarily inſpired with Supernatural Truths, ſhould notwithſtanding be ſo groſly ignorant of ſo common a Matter as this? Can we believe, if there were any ſuch thing, that *Joſhua*, and *Job*, and *David*, and *Solomon*, *&c.* ſhould know nothing of it? Certainly it muſt needs argue a ſtrong Affectation of Singularity, for a Man to take up any groundleſs Fancy againſt ſuch Ancient and General Authority.

* *Alex. Roſſ de Terræ motu, contra Lansb. l. 1. ſect. 1. cap. 10.*

I anſwer: As we ſhould not be ſo fondly conceited of our ſelves, and the extraordinary Abilities of theſe preſent Ages, as to think every thing that is ancient to be obſolete: Or, as if it muſt needs be with Opinions as it is with Cloaths, where the Neweſt is for the moſt part beſt. So neither ſhould we be ſo ſuperſtitiouſly devoted to Antiquity, as to take up every thing for Canonical, which drops from the Pen of a Father, or was approved by the Conſent of the Anci-

ents

ents. 'Tis an Excellent Saying, * Δεῖ ἐλευθέριον ἔν τῇ γνώμῃ τὸν μέλλοντα φιλοσοφεῖν. It behoves every one in the ſearch of Truth, always to preſerve a Philoſophical Liberty; not to be ſo enſlav'd to the Opinion of any Man, as to think whatever he ſays to be infallible. We muſt labour to find out what things are in themſelves, by our own Experience, and a thorough Examination of their Natures, not what another ſays of them. And if in ſuch an Impartial Enquiry, we chance to light upon a New Way, and that which is beſides the Common Road, this is neither our Fault, nor our Unhappineſs.

* *Alcinous.*

Not our Fault, becauſe it did not ariſe from Singularity or Affectation. Not our Unhappineſs, becauſe it is rather a Privilege to be the firſt in finding out ſuch Truths as are not diſcernible to every Common Eye. If Novelty ſhould always be rejected, neither would Arts have arrived to that Perfection wherein now we enjoy them, nor could we ever hope for any future Reformation: Though all Truth be in it ſelf eternal, yet in reſpect of Mens Opinions, there is ſcarce any ſo ancient but had a beginning, and was once counted a Novelty; and if for this Reaſon it had been condemned as an Error, what a general Darkneſs and Ignorance would then have been in the World, in compariſon of that Light which now abounds; according to that of the Poet;

* *Quod ſi tam Antiquis Novitas inviſa fuiſſet,*
Quam nobis, quid nunc eſſe vetus aut quid haberet,
Quod legeret tereretque viritim publicus uſus?

* *Horat. lib. 2. ep. 1.*

If our Forefathers had but hated thus,
All that were new; what had been old to us?
Or, how might any thing confirmed be,
For publick uſe by its Antiquity?

But for more full ſatisfaction of all thoſe Scruples that may ariſe from the ſeeming Novelty or Singularity of this Opinion, I ſhall propoſe theſe following Conſiderations.

Conſid. 1. Suppoſe it were a Novelty, yet 'tis in Philoſophy, and that is made up of nothing elſe; but receives addition from every Day's Experiment. True indeed, for Divinity we have an Infallible Rule that does plainly inform us of all neceſſary Truths; and therefore the Primitive Times are of greater Authority, becauſe they were nearer to thoſe Holy Men who were the Penmen of Scripture. But now for Philoſophy, there is no ſuch Reaſon: Whatever the Schoolmen may talk, yet *Ariſtotle*'s Works are not neceſſarily true, and he himſelf hath by ſufficient Arguments proved himſelf to be liable unto Error. Now in this Caſe, if we ſhould ſpeak properly, Antiquity does conſiſt in the Old Age of the World, not in the Youth of it. In ſuch Learning as may be increaſed by freſh Experiments and new Diſcoveries; 'tis we are the Fathers, and of more Authority than former Ages; becauſe we have the advantage of more Time than they had, and Truth (we ſay) is the Daughter of Time. However, there is nothing in this Opinion ſo magiſterially propoſed, but the Reader may uſe his own liberty; and if all the Reaſons conſidered together do not ſeem convincing unto him, he may freely reject it.

In thoſe Natural Points which carry with them any Doubt or Obſcurity, it is the ſafeſt way to ſuſpend our Aſſents; and though we may diſpute *pro* or *con*, yet not to ſettle our Opinion on either Side.

Conſid. 2. In weighing the Authority of others, 'tis not their Multitude that ſhould prevail, or their Skill in ſome things that ſhould make them of credit in every thing; but we ſhould examine what particular inſight and experience they had in thoſe Things for which they are cited. Now 'tis plain, that Common People judge by

by their Senſes, and therefore their Voices are altogether unfit to decide any Philoſophical Doubt, which cannot well be examined or explained without Diſcourſe and Reaſon. And as for the Ancient Fathers, though they were Men very eminent for their Holy Lives, and extraordinary Skill in Divinity, yet they were moſt of them very ignorant in that part of Learning which concerns this Opinion; as appears by many of their groſs Miſtakes in this kind; as that concerning the *Antipodes*, *&c.* And therefore it is not their Opinion neither, in this Buſineſs, that to an indifferent Seeker of Truth will be of any ſtrong Authority.

But againſt this it is * objected, That the Inſtance of the *Antipodes* does not argue any ſpecial Ignorance in theſe Learned Men; or that they had leſs skill in ſuch Human Arts than others; ſince *Ariſtotle* himſelf, and *Pliny*, did deny this as well as they. * *Alex. Roſſ. l.* 1. *ſect. c.* 8.

I anſwer:

1. If they did, yet this does make more to the preſent purpoſe: For if ſuch great Scholars, who were ſo eminent for their Knowledge in Natural Things, might yet notwithſtanding be groſly miſtaken in ſuch Matters as are now evident and certain, why then we have no Reaſon to depend upon their Aſſertions or Authorities, as if they were infallible.

2. Though theſe great Naturaliſts, for want of ſome Experience, were miſtaken in that Opinion, whilſt they thought no Place was habitable but the Temperate *Zones*: Yet it cannot be from hence inferr'd that they denied the poſſibility of *Antipodes*; ſince theſe are ſuch Inhabitants as live oppoſite unto us in the other Temperate *Zone*: And 'twere an abſurd thing to imagine that thoſe who liv'd in different *Zones*, can be *Antipodes* to one another; and argues that a Man did not underſtand, or elſe had forgotten that Common Diſtinction in *Geography*, wherein the Relation of the World's Inhabitants unto one another are reckoned

up

up under these three Heads; *Antaci*, *Periæci*, and *Antipodes*. But to let this pass: 'Tis certain, that some of the Fathers did deny the Being of any such, upon other more absurd Grounds. Now if such as *Chrysostom*, *Lactantius*, &c. who were noted for great Scholars; and such too as flourished in these later times, when all human Learning was more generally profess'd, should notwithstanding be so much mistaken in so obvious a Matter: Why then may we not think that those Primitive Saints, who were the Penmen of Scripture, and eminent above others in their Time for Holiness and Knowledge; might yet be utterly ignorant of many Philosophical Truths, which are commonly known in these Days? 'Tis probable, that the Holy Ghost did inform them only with the Knowledge of those things whereof they were to be the Penmen, and that they were not better skilled in Points of Philosophy than others. There were indeed some of them who were supernaturally endowed with human Learning; yet this was, because they might thereby be fitted for some particular Ends, which all the rest were not appointed unto: Thus *Solomon* was strangely gifted with all kind of Knowledge, in a great measure; because he was to teach us by his own Experience the extream Vanity of it, that we might not so settle our Desires upon it, as if it were able to yield us Contentment. So too the Apostles were extraordinarily inspired with the Knowledge of Languages, because they were to Preach unto all Nations. But it will not hence follow, that therefore the other Holy Penmen were greater Scholars than others. 'Tis likely that *Job* had as much human Learning as most of them, because his Book is more especially remarkable for lofty Expressions, and Discourses of Nature; and yet 'tis not likely that he was acquainted with all those Mysteries which later Ages have discovered; because when God would convince him of his own Folly and Ignorance, he proposes to him such Questions, as being altogether unanswerable;

Eccl. 1.18.

ſwerable; which notwithſtanding, any ordinary Philoſopher in theſe Days might have reſolved. As you may ſee at large in the thirty eighth Chapter of that Book.

The Occaſion was this: *Job* having * before deſired that he might diſpute with the Almighty concerning the Uprightneſs of his own Ways, and the Unreaſonableneſs of thoſe Afflictions which he underwent, does at length obtain his Deſire in this kind; and God vouchſafes in this thirty eighth Chapter, to argue the Caſe with him. Where he does ſhew *Job* how unfit he was to judge of the Ways of Providence, in diſpoſing of Bleſſings and Afflictions; when as he was ſo ignorant in ordinary Matters, being not able to diſcern the Reaſon of natural and common Events. As * why the Sea ſhould be ſo bounded from overflowing the Land? What is the † Breadth of the Earth? What is the * Reaſon of the Snow or Hail? What was the † Cauſe of the Rain or Dew, of Ice and Froſt, and the like. By which Queſtions, it ſeems, *Job* was ſo utterly puzzled, that he is fain afterwards to humble himſelf in this Acknowledgment: * *I have utterred that I underſtood not, things too wonderful for me, which I knew not. Wherefore I abhor my ſelf, and repent in duſt and aſhes.*

So that 'tis likely theſe holy Men had not theſe human Arts by any ſpecial Inſpiration, but by Inſtruction and Study, and other ordinary Means; and therefore *Moſes* his Skill in this kind is called the Learning of the *Egyptians*. Now, becauſe in thoſe times all Sciences were taught only in a rude and imperfect Manner; therefore 'tis likely that they alſo had but a dark and confuſed Apprehenſion of Things, and were liable to the common Errors. And for this Reaſon is it, why * *Toſtatus* (ſpeaking of *Joſhua*'s bidding the Moon ſtand ſtill as well as the Sun) ſays, *Quod forte erat imperitus circa Aſtrorum doctrinam, ſentiens ut vulgares ſentiunt*: That perhaps he was unskilful in Aſtronomy, having the ſame groſs Conceit of the Heavens, as the Vul-

* *Cap.* 13. 3.

* *V.* 8, 10, 11.

† *Ver.* 18.
* *Ver.* 22.
† *Ver.* 28, 29.

* *Cap.* 42. *ver.* 3, 6.

Acts 7. 22.

**Joſh. c.* 10. *Quæſt.* 19.

Vulgar had. From all which it may be inferred, that the Ignorance of such good Men and great Scholars concerning these Philosophical Points, can be no sufficient Reason, why after Examination we should deny them, or doubt of their Truth.

Consid. 3. 'Tis considerable, that in the Rudiments and first Beginnings of Astronomy, and so in several Ages after, this Opinion hath found many Patrons, and those too Men of eminent Note and Learning. Such was more especially *Pythagoras*, who was generally and highly esteemed for his Divine Wit, and rare Inventions; under whose mysterious Sayings, there be many excellent Truths to be discovered.

* *Alex. Ros. l.* 2. *Sect.* 2. *c.* 10. But against his Testimony, it is again* objected; If *Pythagoras* were of this Opinion, yet his Authority should not be of any Credit, because he was the Author of many other monstrous Absurdities.

To this I answer; If a Man's Error in some particulars should take away his Credit for every thing else, this would abolish the Force of all human Authority; for *humanum est errare*. Secondly, 'tis probable that many of *Pythagoras*'s Sayings which seem so absurd, are not to be understood according to their Letter, but in a mystical Sense.

2. But he objects again, That *Pythagoras* was not of this Opinion; and that for two Reasons; First, because no ancient Author that he had read ascribes it unto him. Secondly, it is contradictory to his other Opinions, concerning the Harmony that was made by the Motion of the Heavens; which could not consist with this other of the Earth's Motion.

To the first I answer; The Objector could not chuse but know that this Assertion is by many ancient Authors ascribed to that Sect whereof *Pythagoras* was the Chief. He might have seen it expresly in * *Aristotle* himself. * *De Cælo. l.* 2. *c.* 13. Οἱ δὲ Πυθαγόρειοι λέγουσιν ὅτι μὲν τὸ μέσον πῦρ ἐστὶ, τὴν τε γῆν ἓν τῶν ἄστρων ὄσαν κύκλῳ φερομένην περὶ μέσον, νύκτα τε καὶ ἡμέραν ποιεῖν.

In

In which the Philoſopher does compendiouſly reckon up the three chief Particulars implyed in the Opinion of the *Pythagoreans*. Firſt, the Sun's being in the Centre of the World. Secondly, the Earth's Annual Motion about it, as being one of the Planets. Thirdly, its diurnal Revolution, whereby it cauſed Day and Night.

To his Second Reaſon I anſwer; Firſt, that *Pythagoras* thought the Earth to be one of the Planets (as appears by *Ariſtotle*'s Teſtimony concerning him;) and to move amongſt the reſt. So that his Opinion concerning the Motion of the Heavens, is not inconſiſtent with that of the Earth. Secondly, but as for the Celeſtial Harmony, he might perhaps under this Myſtical Expreſſion, according to his uſual Cuſtom, ſhadow forth unto us that mutual Proportion and Harmonical Conſent, which he did conceive in the ſeveral Bigneſs, Diſtance, Motions of the Orbs. So that notwithſtanding theſe Objections, it is evident that *Pythagoras* was of this Opinion, and that his Authority may add ſomewhat for the Confirmation of it. Unto him aſſented * *Ariſtarchus Samius*, who flouriſhed about 280 Years before the Birth of our Saviour; and was by reaſon of this Opinion, arraigned for Prophanenefs and Sacrilege by the *Areopagites*; becauſe he had blaſphemed the Deity of *Veſta*, affirming the Earth to move. To them agreed *Philolaus*, *Heraclides*, *Pontius*, *Nicetas*, *Syracuſanus*, *Ecphantus*, *Lucippus*, and *Plato* himſelf (as ſome think.) So likewiſe *Numa Pompilius*, as *Plutarch* relates it in his Life; who in reference to this Opinion, built the Temple of *Veſta* round, like the Univerſe; in the middle of it was placed the perpetual Veſtal Fire; by which he did repreſent the Sun in the Centre of the World. All theſe Men were in their ſeveral Times of ſpecial Note, as well for their extraordinary Learning, as for this Opinion.

* *Archimedes de arænæ numero.*

'Tis

4. *Consid.* 'Tis considerable, that since this Science of Astronomy hath been raised to any Perfection, there have been many of the best Skill in it, that have assented unto that Assertion which is here defended. Amongst whom was the Cardinal *Cusanus*, but more especially *Copernicus*, who was a Man very exact and diligent in these Studies for above Thirty Years together, from the Year 1500 to 1530, and upwards; and since him, most of the best Astronomers have been of this side. So that now there is scarce any of Note and Skill, who are not *Copernicus* his Followers; and if we should go to most Voices, this Opinion would carry it from any other. It would be too tedious to reckon up the Names of those that may be cited for it; I will only mention some of the chief: Such were *Joachinus Rheticus*, an elegant Writer; *Christopherus Rothman*; *Mestlin*, a Man very eminent for his singular Skill in this Science; who though at the first he were a Follower of *Ptolemy*, yet upon his second and more exact Thoughts, he concluded *Copernicus* to be in the right; and that the usual *Hypothesis*, * *præscriptione potius quam ratione valet*, does prevail more by Prescription than Reason. So likewise *Erasmus Reinoldus*, who was the Man that calculated the Prutenical Tables from *Copernicus* his Observations, and did intend to write a Commentary upon his other Works, but that he was taken out of this Life before he could finish those Resolutions. Unto these also I might add the Names of *Gilbert*, *Keplar*, *Galilæus*, with sundry others, who have much beautified and confirmed this *Hypothesis*, with their new Inventions. Nay I may safely affirm, that amongst the Variety of those Opinions that are in Astronomy, there are more (of those which have skill in it) that are of this Opinion, not only than any other side, but than all the rest put together. So that now it is a greater Argument of Singularity to oppose it.

De dost. ignor. l. 2. cap. 12.

* *Præf. ad Narrat. Rhetici.*

Ibid.

'Tis probable, that many other of the Ancients would have assented unto this Opinion, if they had been acquainted with those Experiments which later Times have found out for the Confirmation of it: And therefore * *Rheticus* and † *Keplar* do so often wish that *Aristotle* were now alive again. Questionless, he was so rational and ingenious a Man, (not half so obstinate as many of his Followers) that upon such Probabilities as these, he would quickly have renounced his own Principles, and have come over to this side: For in one place, having proposed some Questions about the Heavens, which were not easie to be resolved, he sets down this Rule; That in Difficulties, a Man may take a liberty to speak that which seems most likely to him; and in such Cases, an aptness to guess at some Resolution, for the satisfying of our Philosophical Thirst, does deserve rather to be stiled by the Name of Modesty, than Boldness. And in another place, he refers the Reader to the different Opinions of Astronomers, advising him to examine their several Tenents, as well *Eudoxus* as *Calippus*; and to entertain that (not which is most ancient, but) which is most exact and agreeable to Reason. And as for *Ptolomy*, 'tis his Counsel, that we should endeavour to frame such Suppositions of the Heavens, as might be more simple, being void of all Superfluities: And he confesses, that his *Hypothesis* had many Implications in it, together with sundry intricate and unlikely Turnings; and therefore in the same place, he seems to admonish us, that we should not be too confident the Heavens were really in the same Form wherein Astronomers did suppose them. So that 'tis likely, 'twas his chief intent to propose unto us such a Frame of the Celestial Bodies, from which we might, in some measure, conceive of their different Appearances; and according to which, we might be able to calculate their Motions. But now 'tis *Copernicus* his endeavour, to propound unto us the true natural Causes

5 *Consid.*

* *In Narratione.*
† *Myst. Cosmogr. c.* 1. *Item præf. ad* 4. *l. Astr. Copern.*

De Cæl. l. 2. *c.* 12.

Met. lib. 12. *cap.* 8.

Alm. l. 13. *cap.* 2.

ſes of theſe ſeveral Motions and Appearances: It was the intent of the one, to ſettle the Imagination; and of the other, to ſatisfie the Judgment. So that we have no reaſon to doubt of his Aſſent unto this Opinion, if he had but clearly underſtood all the Grounds of it.

'Tis reported of *Clavius*, that when lying upon his Death-Bed, he heard the firſt News of thoſe Diſcoveries which were made by *Galilæus*'s Glaſs, he brake forth into theſe Words: *Videre Aſtronomos, quo pacto conſtituendi ſunt orbes Cæleſtes, ut hæc Phænomena ſalvari poſſint*; That it did behove Aſtronomers to conſider of ſome other *Hypotheſis*, beſide that of *Ptolomy*, whereby they might ſolve all thoſe new Appearances. Intimating that this old one, which formerly he had defended, would not now ſerve the turn: And doubtleſs, if he had been informed how congruous all theſe might have been unto the Opinion of *Copernicus*, he would quickly have turned on that ſide. 'Tis conſiderable, that amongſt the Followers of *Copernicus*, there are ſcarce any who were not formerly againſt him; and ſuch, as at firſt had been throughly ſeaſoned with the Principles of *Ariſtotle*; in which, for the moſt part, they have no leſs skill than thoſe who are ſo violent in the defence of them. Whereas on the contrary, there are very few to be found amongſt the Followers of *Ariſtotle* and *Ptolomy*, that have read any thing in *Copernicus*, or do fully underſtand the Grounds of his Opinion; and I think, not any, who having been once ſettled with any ſtrong Aſſent on this ſide, that have afterwards revolted from it. Now if we do but ſeriouſly weigh with our ſelves, that ſo many ingenious, conſidering Men, ſhould reject that Opinion which they were nurſed up in, and which is generally approved as the Truth; and that for the embracing of ſuch a *Paradox* as is condemned in Schools, and commonly cryed down, as being abſurd and ridiculous: I ſay, if a Man do but well conſider all this, he muſt needs

needs conclude, that there is some strong Evidence for it to be found out by Examination; and that in all probability, this is the righter side.

7 Consid. 'Tis probable, that most of those Authors who have opposed this Opinion, since it hath been confirmed by new Discoveries, were stirred up thereunto by some of these Three insufficient Grounds.

1. An over-fond and partial Conceit of their proper Inventions. Every Man is naturally more affected to his own Brood, than to that of which another is the Author; though perhaps it may be more agreeable to Reason. 'Tis very difficult for any one, in the search of Truth, to find in himself such an Indifferency, as that his Judgment is not at all swayed by an over-weaning Affection unto that which is proper unto himself. And this perhaps might be the first Reason that moved the noble *Tycho* with so much heat to oppose *Copernicus*, that so he might the better make way for the spreading of that *Hypothesis* which was of his own Invention. To this I might likewise refer that Opinion of *Origanus* and Mr. *Carpenter*, who attribute to the Earth only a Diurnal Revolution. It does more especially concern those Men that are *Leaders* of several Sides, to beat down any that should oppose them.

2. A servile and superstitious fear of Derogating from the Authority of the Ancients, or opposing that Meaning of Scripture-Phrases, wherein the supposed Infallible Church hath for a long time understood them. 'Tis made part of the new Creed, set forth by *Pius* the Fourth, 1564. That no Man should assent unto any Interpretation of Scripture, which is not approved of by the Authority of the Fathers. And this is the reason why the Jesuits, who are otherwise the greatest Affectors of those Opinions which seem to be new and subtil, do yet forbear to say any thing in defence of this; but rather take all Occasions to inveigh against it. * One of them does expressly condemn it for a Heresie. And since him, it hath been

* *Serrarius Commen. in Jos. cap.* 10. *Quæst.* 14. So *Lessius Physiol. l.* 2.

* *Ann. Dom.* 1616. *item* 1633.

called in by * two Seſſions of the Cardinals, as being an Opinion both abſurd and dangerous. And therefore likewiſe do they puniſh it, by caſting the Defenders of it into the Pope's trueſt Purgatory, the Inquiſition: But yet neither theſe Councils, nor any (that I know of) ſince them, have proceeded to ſuch a peremptory Cenſure of it, as to conclude it a Hereſie; fearing perhaps, leſt a more exact Examination, and the Diſcovery of future Times, finding it to be an undeniable Truth, it might redound to the prejudice of their Church, and its Infallibility. And therefore he that is moſt bitter againſt it, in the heat and violence of Oppoſition, will not call it a Hereſie: The worſt that he dares ſay of it, is, That it is *opinio temeraria quæ altero ſaltem pede intravit hæreſios limen*: A raſh Opinion, and bordering upon Hereſie. Though unto this likewiſe he was incited by the eagerneſs of Diſputation, and a deſire of Victory; for it ſeems many eminent Men of that Church before him, were a great deal more mild and moderate in their Cenſures of it.

Frömondus Antariſt. cap. 6.

Paul the Third was not ſo much offended at *Copernicus*, when he Dedicated his Work unto him.

The Cardinal of *Cuſa* does expreſly maintain this Opinion.

Schonbergius, the Cardinal of *Capua*, did with much Importunity and great Approbation, beg of *Copernicus* the Commentaries that he writ in this kind: And it ſeems the Fathers of the Council of *Trent*, were not ſuch confident Defenders of *Ptolomy*'s *Hypotheſis* againſt *Copernicus*, as many now are. For, ſpeaking of thoſe intricate Subtilties which the Fancies of Men had framed to maintain the Practice of the Church, they compared them to Aſtronomers, who, ſay they, do feign *Excentricks* and *Epicicles*, and ſuch Engines of Orbs, to ſave the *Phænomena*; though they know there are no ſuch things. But now, becauſe this Opinion of *Copernicus* in later Times hath been ſo ſtrictly forbidden and puniſhed, it will concern thoſe of that Religion,

Religion, to take heed of meddling in the defence of it, but rather to ſubmit the liberty of their Reaſon unto the Command of their Superiors, and (which is very abſurd) even in Natural Queſtions, not to aſſent unto any thing but what Authority ſhall allow of.

3. A judging of things by Senſe rather than by Diſcourſe and Reaſon: A tying of the Meaning of Scripture to the Letter of it, and from thence concluding Philoſophical Points, together with an ignorance of all thoſe Grounds and Probabilities in *Aſtronomy*, upon which this Opinion is bottomed. And this, in all likelihood, is the Reaſon why ſome Men, who in other things perhaps are able Scholars, do write ſo vehemently againſt it; and why the Common People in general do cry it down, as being abſurd and ridiculous. Under this Head I might refer the Oppoſition of Mr. *Fuller*, *Al. Roſſ. &c.*

But now, no Prejudice that may ariſe from the bare Authority of ſuch Enemies as theſe, will be liable to ſway the Judgment of an indifferent conſidering Man; and I doubt not but that he who will throughly weigh with himſelf theſe Particulars that are here propounded, may find ſome ſatisfaction for theſe Arguments, which are taken from the ſeeming Novelty and Singularity of this Opinion.

PROP. II.

That there is not any Place in Scriptures, from which (being rightly understood) we may infer the Diurnal Motion of the Sun or Heavens.

IT were happy for us, if we could exempt Scripture from Philosophical Controversies: If we could be content to let it be perfect for that end unto which it was intended, for a Rule of our Faith and Obedience; and not stretch it also to be a Judge of such Natural Truths as are to be found out by our own Industry and Experience: Though the Holy Ghost could easily have given us a full Resolution of all such Particulars; *yet he hath left this Travel to the Sons of Men to be exercised therewith: Mundum reliquit disputationibus hominum*: That being busied for the most part in an Inquisition after the Creatures, we might find the less leisure to wait upon our Lusts, or serve our more sinful Inclinations.

Eccles. 3. 10, 11.

But however, because our Adversaries generally do so much insult in those Arguments that may be drawn from hence; and more especially, because *Pineda* doth for this Reason with so many bitter and empty Reproaches, revile our Learned Countryman, Dr. *Gilbert*; in that renewing of this Opinion, he omitted an Answer to the Scripture Expressions: Therefore 'tis requisite, that in the prosecution of this Discourse, we should lay down such satisfaction as may clear all Doubts that may be taken thence: Especially since the Prejudice that may arise from the misapprehension of those Scripture Phrases, may much disable the Reader from looking on any other Argument with an equal and indifferent Mind.

Comment. in Eccles. c. 1. v. 4.

The

The Places that ſeem to oppoſe this, are of two kinds. Firſt, Such as imply a Motion in the Heavens: Or, Secondly, ſuch as ſeem to expreſs a Reſt and Immobility in the Earth.

Thoſe of the firſt kind ſeem to bear in them the cleareſt Evidence, and therefore are more inſiſted on by our Adverſaries. They may be referred unto theſe Three Heads.

1. All thoſe Scriptures where there is any mention made of the riſing or ſetting of the Sun or Stars.

2. That Story in *Joſhua*, where the Sun ſtanding ſtill is reckoned for a Miracle.

3. That other Wonder in the Days of *Hezekiah*, when the Sun went back Ten Degrees in the Dial of *Ahaz*. All which Places do ſeem to conclude, That the Diurnal Motion is cauſed by the Heavens.

To this I anſwer in general;

That the Holy Ghoſt in theſe Scripture Expreſſions, is pleaſed to accommodate himſelf unto the Conceit of the Vulgar, and the uſual Opinion: Whereas, if in the more proper Phraſe it had been ſaid, That the Earth did riſe and ſet; or, that the Earth ſtood ſtill, *&c.* the People who had been unacquainted with that Secret in Philoſophy, would not have underſtood the Meaning of it; and therefore it was convenient that they ſhould be ſpoken unto in their own Language.

Ay, but you will reply, It ſhould ſeem more likely, if there had been any ſuch thing, that the Holy Ghoſt ſhould uſe the trueſt Expreſſions: For then he would at the ſame time have informed them of the Thing, and reformed them in an Error: Since his Authority alone had been ſufficient to have rectified the Miſtake.

I Anſwer:

1. Though it were, yet 'tis beſide the chief Scope of thoſe Places, to inſtruct us in any Philoſophical Points, as hath been proved in the former Book; eſpecially when theſe Things are neither neceſſary in themſelves, nor do neceſſarily induce to a more full underſtanding of that which is the main buſineſs of thoſe Scriptures. But now the People might better conceive the Meaning of the Holy Ghoſt, when he does conform himſelf unto their Capacities and Opinions, than when he talks exactly of Things in ſuch a proper Phraſe as is beyond their reach: And therefore 'tis ſaid in *Iſaiah, I am the Lord which teacheth thee* utilia, *profitable Things*: Where the Gloſs has it, *non ſubtilia*, not ſuch Curioſities of Nature as are not eaſily apprehended.

2. 'Tis not only beſides that which is the chief purpoſe of thoſe Places, but it might happen alſo to be ſomewhat oppoſite unto it. For Men being naturally unapt to believe any thing that ſeems contrary to their Senſes, might upon this begin to queſtion the Authority of that Book which affirmed it, or at leaſt to retch Scripture ſome wrong way, to force it to ſome other Senſe, which might be more agreeable to their own Falſe Imagination. † *Tertullian* tells us of ſome Hereticks, who when they were plainly confuted out of any Scripture, would preſently accuſe thoſe Texts or Books to be fallible, and of no Authority; and rather yield Scripture to be erroneous, than forgo thoſe Tenets for which they thought there was ſo good Reaſon. So likewiſe might it have been in theſe Points which ſeem to bear in them ſo much Contradiction to the Senſes and Common Opinion: And therefore 'tis Excellent Advice ſet down by St. † *Auſtin. Quod nihil credere de re obſcurâ temere debemus, ne forte quod poſtea veritas patefecerit, quamvis libris ſanctis ſive teſtamenti veteris, ſive novi, nullo modo eſſe poſſit adverſum, tamen propter amorem noſtri erroris oderimus:*

† *Præſcript. c. 17.*

† *In Geneſ. ad lit. l. 2. in fine.*

That

That we ſhould not haſtily ſettle our Opinions concerning any obſcure Matter, leſt afterwards, the Truth being diſcover'd, (which however it may ſeem, cannot be repugnant to any thing in Scripture) we ſhould hate that, out of love to the Error that we have before entertained. A little reading may inform us how thoſe Texts have been abuſed to ſtrange and unmeant Allegories, which have mentioned any natural Truth in ſuch a manner as was not agreeable to Mens Conceits. And beſides, if the Holy Ghoſt had propounded unto us any Secrets in Philoſophy, we ſhould have been apt to be ſo buſied about them, as to neglect other Matters of greater importance. And therefore St. *Auſtin* propoſing the Queſtion, What ſhould be the Reaſon, why the Scripture does not clearly ſet down any thing concerning the Nature, Figure, Magnitude and Motion of the Heavenly Orbs; he anſwers it thus: The Holy Ghoſt being to deliver more neceſſary Truths, would not inſert theſe, leſt Men according to the Pravity of their Diſpoſitions, ſhould neglect the more weighty Matters, and beſtow their Thoughts about the ſpeculative natural Points, which were leſs needful. So that it might ſeem more convenient that the Scripture ſhould not meddle with the revealing of theſe unlikely Secrets, eſpecially when it is to deliver unto us many other Myſteries of greater neceſſity, which ſeem to be directly oppoſite to our Senſe and Reaſon. And therefore, I ſay, the Holy Ghoſt might purpoſely omit the treating of theſe Philoſophical Secrets, till Time and future Diſcovery might with leiſure ſettle them in the Opinion of others: As he is pleaſed in other Things of a higher kind, to apply himſelf unto the Infirmity of our Apprehenſions, by being repreſented, as if he were a Human Nature, with the Parts and Paſſions of a Man. So in theſe Things likewiſe, that he might deſcend to our Capacities, does he vouchſafe to conform his Expreſſions unto the Error and Miſtake of our Judgments.

Ibid. cap. 9.

But before we come to a further Illuſtration, let us a little examine thoſe particular Scriptures which are commonly urged to prove the Motion of the Sun or Heavens. Theſe (as was ſaid) might be diſtributed under theſe Three Heads.

* *Pſal.* 19. 5, 6. 1. Thoſe Places which mention the riſing or ſetting of the Sun; as that in the * *Pſalm, The Sun like a Bridegroom cometh out of his Chamber, and rejoiceth as a Giant to run his Race: His going forth is from the end of Heaven, and his circuit unto the end of it, and there is nothing hid from the heat thereof.* And that in *Eccleſiaſtes, The Sun*

Eccleſ. 1. 5. *ariſeth, and the Sun goeth down,* &c.

In which Scriptures we may obſerve divers Phraſes that are evidently ſpoken in reference to the appearance of Things, and the Falſe Opinion of the Vulgar. And therefore 'tis not altogether unlikely, That this, which they ſeem to affirm concerning the Motion of the Heavens, ſhould alſo be underſtood in the ſame Senſe.

The Sun like a Bridegroom cometh out of his Chamber; Alluding perhaps unto the Conceit of Ignorant People: As if it took reſt all the while it was abſent from us, and came out of its Chamber when it aroſe.

And rejoiceth as a Giant to run his Race; becauſe in the Morning it appears bigger than at other Times; and therefore in reference to this Appearance, may then be compared unto a *Giant*.

His going forth is from the end of Heaven, and his Circuit unto the ends of it. Alluding again unto the Opinion of the Vulgar: Who not apprehending the Roundneſs of the Heavens, do conceive it to have two Ends, one where the Sun riſeth, the other where it ſetteth.

And there is nothing hid from the Heat thereof; ſpeaking ſtill in reference to the common Miſtake, as if the Sun were actually hot in it ſelf; and as if the Heat of the Weather were not generated by reflection, but

but did immediately proceed from the Body of the Sun.

So likewiſe, for that in *Eccleſiaſtes*, where 'tis ſaid, *The Sun riſeth, and the Sun goeth down*, &c. which Phraſes being properly underſtood, do import that he is ſometimes in a higher place than at others: Whereas, in a Circumference, there is no Place higher or lower, each part being at the ſame diſtance from the Centre, which is the Bottom. But now underſtand the Phraſe in reference to the Sun's appearance, and then we grant that he does ſeem ſometimes to riſe, and ſometimes to go down, becauſe in reference to the *Horizon*, (which Common People apprehend to be the Bottom, and in the utmoſt Bounds of it to join with the Heavens,) the Sun does appear in the Morning to riſe up from it, and in the Evening to go down unto it. Now, I ſay, becauſe the Holy Ghoſt, in the manner of theſe Expreſſions, does ſo plainly allude unto Vulgar Errors, and the Falſe Appearance of Things; therefore 'tis not without probability, that he ſhould be interpreted in the ſame Senſe, when he ſeems to imply a Motion in the Sun or Heavens.

2. The Second Place was that Relation in *Joſhua*; where 'tis mention'd as a Miracle, That the Sun did ſtand ſtill. And *Joſhua* ſaid, *Sun ſtand thou ſtill upon Gibeon, and thou Moon in the Valley of Ajalon. So the Sun ſtood ſtill in the midſt of Heaven, and haſted not to go down about a whole Day. And there was no Day like that, before it, or after it.* In which Place likewiſe there are divers Phraſes wherein the Holy Ghoſt does not expreſs Things according to their true Nature, and as they are in themſelves; but according to their Appearances, and as they are conceived in Common Opinion. As,

Joſ. 10. 12. 14. *Galilæus* maintains the Literal Senſe of this Place, towards the end of that Treatiſe, which he calls, *Nov. Antiq. pat. doctrina.*

1. When he ſays, *Sun ſtand thou ſtill upon Gibeon*, or over *Gibeon*. Now the whole Earth being ſo little in compariſon to the Body of the Sun, and but as a Point,

in

in reſpect of that Orb wherein the Sun is ſuppoſed to move; and *Gibeon* being, as it were, but a Point of this Globe of Earth; therefore the Words cannot be underſtood properly, but according to appearance. 'Tis probable that *Joſhua* was then at *Azecha*, a little Eaſt from *Gibeon*, and the Sun being ſomewhat beyond the Meridian, did ſeem unto him as he was in that Place, to be over againſt *Gibeon*; and in reference to this Appearance, and Vulgar Conceit, does he command it to ſtand ſtill upon that Place.

Toſtat. in locum, Quæſt. 16, 17. Arius Montanus in locum.

2. And ſo ſecondly for that other Expreſſion; *And thou Moon in the Valley of Ajalon.* This Planet was now a little Eaſt from the Sun, it being about three or four Days old (as † Commentators gueſs.) *Ajalon* was three Miles from *Gibeon* Eaſtward, and *Joſhua* commanded the Moon to ſtand ſtill there; becauſe unto him it did then ſeem to be over-againſt that Valley; whereas, 'tis certain, if he had been there himſelf, it would ſtill have ſeemed to be as much diſtant from him. Juſt as men commonly ſpeak in ſhewing another the Stars: We point to a Star over ſuch a Chimney, or ſuch a Tree, becauſe to us it appears ſo; whereas the Star in it ſelf is not ſenſibly more over them, than it is over us. So that in this Phraſe likewiſe the Holy Ghoſt doth conform himſelf unto the appearance of things, and our groſſer Conceit.

† *Toſtat. ib. Quæſt. 18. Serrarius in Joſh. 10. Quæſ. 21. 22.*

3. *And the Sun ſtood ſtill in the midſt of Heaven.* Now to ſpeak properly, and as the Thing is in it ſelf, Heaven has no midſt but the Centre; and therefore this alſo muſt be intepreted in reference to the Opinion of the Vulgar; and by the midſt of Heaven, we are to underſtand ſuch a Place as was not very near to either of the Ends, the Eaſt or Weſt.

4. *And there was no Day like that, before it, or after it*: Which Words are not to be underſtood abſolutely, for there are always longer Days under the Poles; but in reſpect to the Opinion of the Vulgar; that is, there was never any Day ſo long which theſe ignorant People knew of.

3. As

3. As for this laſt Place concerning the Sun's returning Ten Degrees in the Dial of *Abaz*: I think it may probably be affirmed, That it is to be underſtood only concerning the Shadow: Which though it do neceſſarily happen in all Horizontal Dials, for any Latitude betwixt the Tropicks: And ſo conſequently in all declining Dials, the Elevation of whoſe Pole is leſs than the Sun's greateſt Declination; as *Clavius de Horol. cap.* 21. obſerves: Yet the Circumſtances of this Relation in Scripture, make the Event to differ from that other which is common and natural: Which againſt its Nature did ſeem to go backwards, when as the Sun it ſelf was not in the leaſt manner altered from its uſual Courſe. Of this Opinion were *Abarbinel*, *Arius Montanus*, *Burgenſis*, *Vatablas Sanctius*, &c. 2King.20. 11. Iſa. 38. 8.

The Reaſons for it may be theſe;

1. The Miracle is propoſed only concerning the Shadow; *Wilt thou that the Shadow ſhall aſcend or return by Ten Degrees*: There being not in the Offer of this Wonder, any the leaſt mention made concerning the Sun's going backwards.

2. 'Tis likely we ſhould have had ſome Intimation concerning the extraordinary Length of the Day, as it is in that of *Joſhua*; but in this Relation, the chief Matter that the Story takes notice of, is the Alteration of the Shadow.

3. Had it been by the ſuppoſed return of the Sun's Body, this had been a greater Miracle than thoſe which were performed upon more ſolemn Occaſions; it had been more wonderful than its ſeeming Reſt in *Joſhua*'s Time; than the ſupernatural Eclipſe at our Saviour's Death, when the Moon was in the Full. And then it is not likely, that the Holy Ghoſt in relating of this Miracle, ſhould chiefly inſiſt in expreſſing how the Shadow returned, and that only in the Dial of *Abaz*.

4. This Sign did not appear in the Sun it ſelf; becauſe in the 2. *Chron.* 32 31. 'tis ſaid, That *the Ambaſ-*

baſſadors of the King of Babylon did come unto Hezekiah, to enquire of the wonder that was done in the Land; and therefore it ſeems the Miracle did not conſiſt in any Change of the Heavens.

5. If it had been in the Sun, it would have been as well diſcerned in other parts of the World, as in the Land of *Judea*. And then,

1. What need the King of *Babylon* ſend thither to enquire after it? If you reply, becauſe it was occaſioned by *Hezekiah*'s Recovery; I anſwer, 'tis not likely that the Heathens would ever believe ſo great a Miracle ſhould be wrought meerly for a Sign of one Man's Recovery from a Diſeaſe: But would rather be apt to think that it was done for ſome more remarkable Purpoſe, and that by ſome of their own Gods, unto whom they attributed a far greater Power than unto any other. 'Tis more probable, they might hear ſome flying Rumor of a Miracle that was ſeen in *Judea*: Which becauſe it happened only in *Hezekiah*'s Houſe and Dial, and that too upon his Recovery from a dangerous Sickneſs, they might be more apt to believe that it was a Sign of it.

2. Why have we no mention made of it in the Writings of the Ancients? It is no way likely, that ſo great a Miracle as this was (if it were in the Sun) ſhould have been paſſed over in Silence; eſpecially, ſince it happened in thoſe later times, when there were many Heathen Writers that flouriſhed in the World; *Heſiod*, *Archilochus*, *Symonides*; and not long after, *Homer*, with divers others; and yet none of them have the leaſt mention of any ſuch Prodigy. We have many Relations of Matters that were leſs obſervable, which were done about that time; the Hiſtory of *Numa Pompilius*, *Gyges*; the Fight betwixt the three Brethren, with divers ſuch Stories. And 'tis ſcarce credible, that this ſhould have been omitted amongſt the reſt.

Nay,

Nay, we have (as many gueſs) ſome Hints from Prophane Antiquity, of the Miracle wrought by *Joſhua*. Unto which, 'tis thought the Ancients did allude in the Fable of *Phaeton*; when the Sun was ſo irregular in his Courſe, that he burnt ſome part of the World. And queſtionleſs then, this which happened in later times, would not have been ſo wholly forgotten. 'Tis an Argument urged by * *Origen*, That the Eclipſe at our Saviour's Paſſion was not univerſal, becauſe no Prophane Author of thoſe times mentions it. Which Conſequence is the very ſame with that which is urged in this other caſe; but by the way, his Antecedent was falſe, ſince † *Tertullian* affirms, That it was recorded amongſt the *Roman* Annals.

* *Tractat.* 35. *in Mat.*

† *Apologet.* c. 21.

Now as for that Story in *Herodotus*, where after he had related the Flight of *Senacherib*, he tells us, how the Sun did Four Times in the Space of 10340 Years invert his Courſe, and riſe in the *Weſt*; which would ſeem ſo unto other Nations, if he had only returned, as many conclude, from this Scripture: As for this Story, (I ſay) it cannot well be urged as pertinent to the preſent Buſineſs, becauſe it ſeems to have Reference unto times that never were.

Lib. 2.

So that all theſe things being well conſidered, we ſhall find it more probable, that this Miracle doth conſiſt in the Return of the Shadow.

If you object, That the Scripture does expreſly ſay, *the Sun it ſelf returned ten degrees*; I anſwer, 'tis a frequent Manner of Speech in Scripture, to put the Cauſe for the Effect; as that in *Jonas*, where 'tis ſaid, That *the Sun did beat upon the head of Jonas*; that is, the Beams of the Sun. So that of the Pſalmiſt, *The Sun ſhall not ſmite thee by day*, that is, the Heat which proceeds from the Sun's Reflection. In the ſame Senſe may the Phraſe be underſtood in this Place; and the Sun may be ſaid to return back, becauſe the Light, which is the Effect of it, did ſeem to do ſo; or rather,

Iſa. 38. 8.

Jonah 4. 8.

Pſal. 121. 6.

ther, becauſe the Shadow, which is the Effect of that did change its Courſe.

This later Scripture then, will not at all make to the preſent Purpoſe: As for thoſe of the two former kinds, I have already anſwered, That they are ſpoken in reference to the Appearance of Things, and vulgar Opinion. For the further Illuſtration of which, I ſhall endeavour to confirm theſe two Particulars.

1. That the Holy Ghoſt in many other Places of Scripture, does accommodate his Expreſſions unto the Error of our Conceits: And does not ſpeak of divers Things as they are in themſelves, but as they appear unto us. Therefore 'tis not unlikely, that theſe Phraſes alſo may be liable unto the ſame Interpretation.

2. That divers Men have fallen into great Abſurdities, whilſt they have looked for the Grounds of Philoſophy from the Words of Scripture; and therefore it may be dangerous in this Point alſo, to adhere ſo cloſely unto the Letter of the Text.

PROP. III.

That the Holy Ghoſt, in many Places of Scripture, does plainly conform his Expreſſions unto the Errors of our Conceits; and does not ſpeak of divers Things as they are in themſelves, but as they appear unto us.

THere is not any particular by which Philoſophy hath been more endamaged, than the ignorant Superſtition of ſome Men: Who in ſtating the Controverſies of it, do ſo cloſely adhere unto the meer Words of Scripture. *Quam plurima occurrunt in libris ſacris ad naturam pertinentia*, &c. They are the Words of † *Valleſius*. "There are ſundry Things in Holy

† *Præm. ad Phil. ſacram.*

"Writ

" Writ concerning natural Points, which moſt Men " think are not ſo to be underſtood, as if the Holy " Ghoſt did intend to unfold unto us any thing in that " kind: But referring all to the Salvation of our " Souls, does ſpeak of other Matters according to " common Opinion." And a little after, *Ego, divina hæc eloquia*, &c. " I for my part am perſuaded, " that theſe Divine Treatiſes were not written by the " Holy and Inſpired Penmen, for the Interpretation " of Philoſophy, becauſe God left ſuch things to be " found out by Men's Labour and Induſtry. But yet " whatſoever is in them concerning Nature is moſt " true: As proceeding from the God of Nature, from " whom nothing could be hid." And queſtionleſs, all thoſe things which the Scripture does deliver concerning any natural Point, cannot be but certain and infallible, being underſtood in that Senſe, wherein they were firſt intended; but now that it does ſpeak ſometimes according to common Opinion, rather than the true Nature of the things themſelves, was intimated before; wherefore (by the way) * *Fromondus* his Triumph upon the latter Part of this Quotation, is but vain, and to no purpoſe. 'Tis a good Rule ſet down by a learned † Commentator, to be obſerved in the Interpretation of Scripture: *Scriptura Sacra ſæpe non tam ad veritatem ipſam, quam ad hominum opinionem, ſermonem accommodat*; that it does many times accommodate its Expreſſions, not ſo much to the Truth it ſelf, as to Men's Opinions. And in this Senſe is that Speech of *Gregory* concerning Images and Pictures, attributed by * *Calvin* unto the Hiſtory of the Creation; *viz. Librum eſſe ideotarum*, that it is a Book for the ſimpler and ignorant People. For it being written to inform them, as well as others, 'tis requiſite that it ſhould uſe the moſt plain and eaſie Expreſſions. To this purpoſe likewiſe is that of † *Merſennus*, *Mille ſunt Scriptura loca*, &c. " There are very many Places of Scripture, " which are not to be interpreted according to the Let-

" ter;

* *Veſt. Tract.* 3. *c.* 2.

† *Sanctius in Iſa.* 13. 5. *Item in Zachar. l.* 9. *n.* 45.

* *Comment. in Gen. c.* 1.

† *In Gen. c.* 1. *v.* 10. *art.* 6.

Vid. Hiero. in Jer. 28. Aquinas in Job. 26. 7.

"ter; and that for this Reaſon, becauſe God would "apply himſelf unto our Capacity and Senſe: *Preſertim in iis, quæ ad res naturales, oculiſque ſubjectas pertinent*; more eſpecially in thoſe things which concern Nature, and are ſubject to our Eyes. And therefore in the very ſame Place, though he be eager enough againſt *Copernicus*, yet he concludes that Opinion not to be a Hereſy; becauſe (ſaith he) thoſe Scriptures which ſeem to oppoſe it, are not ſo evident, but that they may be capable of another Interpretation: Intimating, that it was not unlikely they ſhould be underſtood in reference to outward Appearance and common Opinion: And that this manner of Speech is frequently uſed in many other Places of Scripture, may be eaſily manifeſt from theſe following Examples.

Thus though the Moon may be proved by infallible Obſervation, to be leſs than any of the viſible Stars; yet becauſe of its Appearance, and vulgar Opinion, therefore doth the Scripture in compariſon to them, call it one of the great Lights. Of which Place, ſaith *Calvin*, *Moſes populariter ſcripſit, nos potius reſpexit quam Sydera.* *Moſes* did not ſo much regard the Nature of the thing, as our Capacity; and therefore uſes a popular Phraſe: So as ordinary People without the Help of Arts and Learning, might eaſily underſtand him; and in another Place, *Non fuit Spiritus Sancti concilium Aſtrologiam docere*: "It was not the "purpoſe of the Holy Ghoſt to teach us Aſtronomy: "But being to propound a Doctrine that concerns "the moſt rude and ſimple People, he does (both by "*Moſes* and the Prophets) conform himſelf unto their "Phraſes and Conceits: Leſt any ſhould think to excuſe his own Ignorance with the Pretence of Difficulty: As Men commonly do in thoſe things which "are delivered after a learned and ſublime Manner."

Gen 1.16. *Pſal.* 136, 7.

Comment. in Pſal. 136.

Thus *Zanchy* † likewiſe, *Moſes majorem rationem habuit noſtri humanique judicii*, &c. "When *Moſes* calls the "Moon

† *De oper. Dei, par.* 2. *l.* 6. *c.* 1.

" Moon a great Light, he had a more eſpecial Refe-
" rence to Men's Opinions of it, than to to the Truth
" of the thing it ſelf; becauſe he was to deal with
" ſuch, who do uſually judge rather by their Senſe
" than by their Reaſon." Nor will that Diſtinction of *Fromondus* and others avoid this Interpretation, when he tells us of *magnum Materiale*, which refers to the Bulk and Quantity of the Body; and *magnum Formale*, which imports the Greatneſs of its Light. For we grant, that it is really unto us a greater Light than any of the Stars, or than all of them together: Yet there is not one of them, but is in its ſelf a bigger Light than this: And therefore when we ſay this Speech is to be underſtood according to its Appearance, we do not oppoſe this to Reality: But 'tis implied, that this Reality is not abſolute, and in the Nature of the thing it ſelf; but only relative, and in reference to us. I may ſay a Candle is a bigger Light than a Star, or the Moon, becauſe it is really ſo to me. However any one will think this to be ſpoken, only in relation to its Appearance, and not to be underſtood as if the thing were ſo in it ſelf. But (by the way) it does concern *Fromondus* to maintain the Scripture's Authority, in revealing of natural Secrets; becauſe, from thence it is that he fetches the chief Argument for that ſtrange Aſſertion of his, concerning the Heavineſs of the Wind; Where *Job* ſays, that *God makes the weight for the wind.* Thus likewiſe, becauſe the common People uſually think the Rain to proceed from ſome Waters in the *Expanſum*, therefore doth *Moſes* in reference to this erroneous Conceit, tell us of Waters above the Firmament, and the Windows of Heaven: Of which ſaith *Calvin*, *Nimis ſerviliter literæ ſe aſtringunt*, &c. " Such Men too ſervilely tie them-
" ſelves unto the Letter of the Text, who hence con-
" clude, that there is a Sea in the Heavens: When as
" we know that *Moſes* and the Prophets, to accommo-
" date themſelves unto the Capacity of ruder People,

De Meteor. l. 4. c. 2. art. 5.

Job 28. 25.

Comment. in Pſa. 148. 4.

" do uſe a vulgar Expreſſion; and therefore it would " be a prepoſterous Courſe, to reduce their Phraſes un- " to the exact Rules of Philoſophy." Let me add, that from this Miſtake, 'tis likely did ariſe that groundleſs Obſervation of the ancient *Jews*, who would not admit any to read the beginning of *Geneſis*, till he was arrived to Thirty Years of Age. The true Reaſon of which was this: Not becauſe that Book was harder than any other, but becauſe *Moſes* conforming his Expreſſion to vulgar Conceits, and they examining of them by more exact Rules of Philoſophy, were fain to force upon them many ſtrange Allegories, and unnatural Myſteries.

Thus alſo, becauſe for the moſt part we conceive the Stars to be innumerable, therefore doth the Holy Ghoſt often ſpeak of them in reference to this Opini-

*Jer.*35.22. on. So *Jeremy*, *As the Hoſt of Heaven cannot be numbred, neither the Sand of the Sea meaſured, ſo will I multiply the Seed of David.* So likewiſe, when God would comfort *Abraham* with the Promiſe of a numberleſs Po-

Gen. 15.5. ſterity, he bids him look up to Heaven, and tells him, that his Seed ſhould be like thoſe Stars for Number; which, ſaith * *Clavius*, *Intelligendum eſt ſecundum com-*

* *In* 1. *cap. Sphæræ.* *munem ſententiam vulgi, exiſtimantis infinitam eſſe multitudinem ſtellarum, dum eas nocte ſerena confuſe intuetur*, is to be underſtood according to the common Opinion of the Vulgar, who think the Stars to be of an infinite Multitude, whilſt they behold them all (as they ſeem confuſed) in a clear Night. And though many of our Divines do commonly interpret this Speech to be a *Hyperbole*; yet being well conſidered, we ſhall find that *Abraham*'s Poſterity, in ſome few Generations, were far more than there are viſible Stars in the Firmament; and of ſuch only does God ſpeak, becauſe he bids *Abraham* look up to the Heavens.

Now all theſe, even unto ſix Differences of Magnitude, are reckoned to be but 1022. True indeed, at the firſt viewing of the Heavens, it may ſeem an in-

credible

credible thing that they ſhould be of no greater a Number; but the reaſon of this is, becauſe they appear ſcattered and confuſed, ſo that the Eye cannot place them in any ſuch order, as to reckon them up, or take any diſtinct Survey of them. Now 'tis a known Truth, *Quod fortius operatur pluralitas partium, ubi ordo abeſt; nam inducit ſimilitudinem infiniti, & impedit comprehenſionem*; That a plurality of Parts without Order, has a more ſtrong Operation, becauſe it has a kind of ſeeming Infinity, and ſo hinders Comprehenſion. And then beſides, there are more Appearances of Stars many times, than there are Bodies of them: For the Eye, by reaſon of its weakneſs and diſability to diſcern any thing at ſo great a diſtance; as alſo, becauſe of thoſe Beams which proceed from ſuch remote Bodies in a twinkling and wavering manner, and ſo mix and confound themſelves at their entrance into that Organ; it muſt needs receive more Repreſentations than there are true Bodies. But now, if a Man do but leiſurely and diſtinctly compare the Stars of the Heaven with thoſe of this Number that are noted in a Cœleſtial Globe, he ſhall ſcarce find any in the Sky which are not marked with the Globe; nay, he may obſerve many in the Globe, which he can ſcarce at all diſcern in the Heavens.

Sir *Fr. Bac.* Table of Colours, *Num.* 5.

Now this Number of the Stars is commonly diſtributed into 48 Conſtellations; in each of which, though we ſhould ſuppoſe Ten thouſand Stars, (which can ſcarce be conceived) yet would not all this Number equal that of the Children of *Iſrael.* Nay, 'tis the Aſſertion of *Clavius*, that *Abraham*'s Poſterity in ſome few Generations were far more than there could be Stars in the Firmament, though they ſtuck ſo cloſe that they touched one another. And he proves it thus: A great Circle in the Firmament does contain the Diameter of a Star of the firſt Magnitude 14960 times. In the Diameter of the Firmament, there are contained 4760 Diameters of ſuch a Star:

In prim. ca. Sphæræ.

Now if we multiply this Circumference by this Diameter, the Product will be 71209600, which is the full Number of Stars, that the eighth Sphere (according to *Ptolemy*'s Grounds) would contain, if they ſtood ſo cloſe that they touched one another.

*Num.*1.46. The Children of *Iſrael* were reckoned at their going out of *Egypt* 603550, of ſuch as were One and Twenty Years old and upwards, and were able to go to War; beſides Children, and Women, and Youths, and old Men, and the *Levites*; which in probability, did always treble the other Number. Now if they were ſo many at one time, we may well conceive that in all thoſe ſeveral Generations, both before and ſince, the Number was much augmented; and long before this time, did far exceed this ſuppoſed Multitude of the Stars. From all which, we may infer, That the Scripture-Expreſſions in this kind, are to be underſtood according to Appearance and common Opinion.

Another Place uſually cited for the ſame purpoſe, to ſhew that the Holy Ghoſt does not ſpeak exactly

1 *King.* 7. 23. 2 *Chr.* 4.2. concerning Natural Secrets, is that in the *Kings* and *Chronicles*, which relates unto us the Meaſure of *Solomon*'s Brazen Sea, whoſe Diameter was ten Cubits, and its Circumference thirty; whereas to ſpeak Geometrically, the more exact proportion betwixt the Diameter and the Circumference, is not as Ten to Thirty, but rather as Seven to Twenty two.

* *Roſſ. l.*1. *ſect.* 1. *c.*8. But againſt this 'tis * objected by our Adverſaries,

1. This Sea was not perfectly round, but rather inclining to a Semicircular Form, as † *Joſephus* affirms.

† *Antiq. Jud. lib.* 8. *cap.* 2. I reply: If it were ſo, yet this is ſo much from helping the Matter, that it makes it much worſe; for then the Diſproportion will be far greater.

But *Secondly*, Scripture, which is to be believed before *Joſephus*, does tell us in expreſs Terms, that it was round all about, 1 *Kings* 7. 23.

2. The

2. The Proportion of the Diameter to the Circumference, is not exactly the same as Seven to Two and twenty, but rather less. I answer, though it be, yet 'tis nearer unto that, than any other Number. *Ross. ibid.*

3. The Scripture does but according to its usual Custom, suppress the less Number, and mention only that which is bigger and more full. So in some * Places, *Abraham*'s Posterity is said to remain in the Land of *Egypt* for Four hundred Years; when as notwithstanding, † other Scriptures tell us, that they tarried there thirty Years longer. Thus likewise in one * Place, the Number of *Jacob*'s House who came into *Egypt*, is reckoned to be Seventy; whereas ∴ elsewhere, they are said to be Seventy five. *Ibid.*

* *Gen.* 15. 13. *Acts* 7. 6.

†*Exod.* 12. 41. *Gal.* 3. 17.

* *Gen.* 46. 27.

∴ *Acts* 7. 4.

I answer: All this is so far from destroying the force of the present Argument, that it does rather confirm it, and more clearly evidence unto us, that the Scripture does not only, not speak exactly in these subtle and more secret Points of Philosophy; but also, in the ordinary obvious numbring of things, does conform unto common Custom, and often use the round Number for the whole.

4. 'Tis yet objected by * another Adversary, That we have no reason to expect the Holy Ghost should reveal unto us this Secret in Nature; because neither *Archimedes*, nor any other, had then found it out. I reply, and why then should we think that the Scripture must needs inform us of the Earth's Motion; when as neither *Pythagoras*, nor *Copernicus*, nor any else, had then discovered it?

* *Fromond. Vesta.* 4. *tract.* 3. *c.* 2.

5. In taking the compass of this Vessel, they measured somewhat below the Brim, where it was narrower than at the Top, and so the Circumference there might be exactly but Thirty Cubits; whereof its Diameter was Ten. *Ibid.*

I answer: 'Tis evident this is a meer Shift, there being not the least Ground for it in the Text. And then besides, why might not we affirm, That the Dia-

meter was measured from that place, as well as the Circumference? since 'tis very probable that the Holy Ghost did speak *ad idem*, and not tell us the breadth of one place, and the compass of another. So that all our Adversaries Evasions cannot well avoid the force of the Argument that is taken from this Scripture.

Again, common People usually conceive the Earrh to be such a Plain, as in its utmost Parts is terminated by the Heavens, so that if a Man were in the farthermost Coasts of it, he might touch the Sky. And hence also, they think that the Reason why some Countries are hotter than others, is, because they lie nearer unto the Sun. Nay, *Strabo* tells us of some Philosophers too, who in this Point have grosly erred; affirming, that there was a Place towards the utmost Coasts of *Lusitania*, where a Man might hear the noise that the Sun made, as he quench'd his Beams in his descent to the Ocean; which, though it be an absurd Mistake, yet we may note, that the Holy Ghost in the Expression of these things, is pleased to conform himself unto such kind of vulgar and false Conceits; and therefore often speaks of the * *ends of Heaven*, and the † *ends of the World*. In this sense, they that come from any far Country, are said to come from the *end of Heaven*, Isaiah 13. 5. And in another Place, *From the side of the Heavens*, Deut. 4. 32. All which Phrases do plainly allude unto the Error of vulgar Capacities (saith *Sanctius*) which hereby is better instructed, than it would be by more proper Expressions.

Psa. 19. 6. *Mat.* 24. 31.

†*Ps.* 22. 27, &c.

Comment. in Isa. 13. 5.

Thus likewise, because ignorant People cannot well apprehend how so great a Weight as the Sea and Land should hang alone in the open Air, without being founded upon some *Basis* to uphold it; therefore in this respect also does Scripture apply it self unto their Conceits, where it often mentions the *Foundations of the Earth*. Which Phrase, in the Letter of it, does manifestly allude unto Men's Imaginations in this kind.

Job 38. 4. *Psa.* 102. 25.

Thus

Thus alſo the Common People uſually conceive the Earth to be upon the Water; becauſe, when they have travelled any way as far as they can, they are at length ſtopped by the Sea. Therefore doth Scripture in reference to this, affirm, That *God ſtretched the Earth upon the Waters, founded the Earth upon the Seas, and eſtabliſhed it upon the Floods.* Of which Places ſaith *Calvin*, *Non diſputat Philoſophicè David, de terræ ſitu; ſed populariter loquens, ad rudium captum ſe accommodat*: 'Twas not *David*'s intent to ſpeak Philoſophically concerning the Earth's Situation; but rather by uſing a popular Phraſe, to accommodate his Speech unto the Capacities of the ruder People. *Pſal.* 136. 6. *Pſal.* 24. 2.

In this ſenſe likewiſe, are we to underſtand all thoſe Places of Scripture, wherein the Coaſts of Heaven are denominated from the Relations of Before, Behind, the right Hand, or the left. Which do not imply, ſaith *Scaliger*, any abſolute difference in ſuch Places; but are ſpoken meerly in reference to Men's Eſtimations, and the common Opinion of thoſe People for whom the Scriptures were firſt penned. Thus becauſe it was the Opinion of the *Jewiſh* Rabbies, that Man was created with his Face to the Eaſt, therefore the *Hebrew* word קדם ſignifies *Ante*, or the Eaſt; אחור *Poſt*, or the Weſt; ימין *Dextra*, or the South, שמאל *Siniſtra*, or the North. You may ſee all of them put together in that Place of *Job*: *Behold I go forward, and he is not there, and backward, but I cannot perceive him; on the left hand, where he doth work, but I cannot behold him. He hideth himſelf on the right hand, that I cannot ſee him.* Which Expreſſions, are by ſome Interpreters referred unto the Four Coaſts of Heaven, according to the common uſe of thoſe Original Words. From hence it is, that many of the Ancients have concluded Hell to be in the North, which is ſignified by the Left Hand: Unto which ſide our Saviour tells us, that the Goats ſhall be divided. Which Opinion likewiſe ſeems to be favoured by that Place in *Job*, *Subtil. Exercit.* 67. *Job* 23. 8, 9. *Mat.* 25. 33.

Job 36. 6, 7. where 'tis said, *Hell is naked before God, and destruction hath no covering.* And presently 'tis added, *He stretched out the North over the empty place.*

Upon these grounds, St. *Jerom* interprets that Speech of the Preacher, *Eccles.* 11. 3. *If the tree falls towards the South, or towards the North, in the place where the tree falleth, there shall it be.* Concerning those who shall go either to Heaven or Hell. And in this Sense also do some expound that of *Zachary*, 14. 4. Where 'tis said, *That the mount of Olives shall cleave in the midst; half of it shall remove towards the North, and half of it towards the South.* By which is intimated, that amongst those *Gentiles* who shall take upon them the Profession of Christ, there are two Sorts; some that go to the *North*, that is, to Hell; and others to the *South*, that is to Heaven. And therefore it is (say they) that God so * often threatens Evil out of the *North*; and upon this ground it is (saith † *Besoldus*) that there is no Religion that worships that way. We read of the *Mahumetans*, that they adore towards the *South*; the *Jews* towards the *West*; Christians towards the *East*, but none to the *North*.

* *Jer*, 1. 14, 15. *Item cap.* 4. 6. 6. 1.

† *L. de nat. pop. c.* 4.

But of this only by the way. However, certain it is that the Holy Ghost does frequently in Scripture set forth the several Coasts of Heaven, by those relative Terms of Right Hand and Left Hand, *&c.* which Expressions do not denote any real intrinsical Difference betwixt those Places, but are rather fitted for the Apprehension of those Men, from whose Fancy it is that they have such Denominations. And though *Aristotle* concludes these several Positions to be natural unto the Heavens; yet his Authority in this particular is not available, because he delivers it upon a wrong ground, supposing the Orbs to be living Creatures, and assisted with Intelligences. We may observe, that the meaning of these Coasts by the Relations of Right Hand and Left Hand, *&c.* is so far from having any ground in the Nature of those several Places, that

De Cæl. l. 2. *c.* 2.

these

theſe Relations are not only variouſly applied unto them by divers Religions (as was ſaid before,) but alſo by divers Arts and Profeſſions. Thus becauſe Aſtronomers make their Obſervations toward the South parts of the *Horizon*, where there be moſt Stars that riſe and ſet; therefore do they account the *Weſt* to be at their Right Hand, and the *Eaſt* at their Left. The *Coſmographers* in taking the Latitude of Places, and reckoning their ſeveral Climates muſt look towards the *North* Pole; and therefore in their Phraſe, by the Right Hand is meant the *Eaſt*; and by the Left Hand, the *Weſt*: And thus (ſaith *Plutarch*, are * we to underſtand theſe Exprſſions in *Pythagoras*, *Plato*, *Ariſtotle*. The Poets count the *South* to be towards the Left, and the *North* the Right Hand. Thus † *Lucan* ſpeaking of the *Arabians* coming unto *Theſſaly*, ſays:

Ignotum vobis Arabes veniſtis in orbem:
Umbras mirati nemorum, non ire ſiniſtras.

The *Augurs* taking their Obſervations at the *Eaſt*, count the *South* to be at their Right Hand, and the *North* their Left: So that theſe Denominations have not any real ground in the Nature of the things, but are impoſed upon them by the Scripture Phraſe, in Reference to the Account and Opinion of the *Jews*.

* *Deplac. Philoſ. l.* 2. cap. 10.

† *Lib.* 3.

Thus alſo, becauſe heretofore it was generally received, that the Heart was the principal Seat of the Faculties; therefore doth the Spirit apply himſelf unto this common Tenent; and in many Places, attributes Wiſdom and Underſtanding to the Heart. Whereas, to ſpeak properly, the Reaſon and diſcurſive Faculties have their principal Reſidence in the Head (ſaith *Galen* and *Hypocrates*, together with the Generality of our later Phyſicians,) becauſe they are hindred in their Operations by the Diſtempers of that part, and recovered by Medicines applied unto it.

D. *Hakwel, Apol. l.* 1. *c.* 1. *Sect.* 2.

Prov. 8. 5. 10. 8. *Eccleſ.* 1. 13, 16, 17. & 8. 5.

So likewiſe are we to underſtand thoſe other Places: *Iſa.* 59. 5. where ſome Tranſlations read it, *Ova Aſpidum ruperunt*, they have broken the Vipers Eggs; alluding

luding to that common but fabulous Story of the Viper, who breaks his Paſſage through the Bowels of the Female. So *Pſal.* 58. 4, 5. where the Prophet ſpeaks of the deaf Adder, *that ſtops her Ears againſt the voice of the Charmer.* Both which Relations (if we may believe many Naturaliſts) are as falſe as they are common; and yet becauſe they were entertained with the general Opinion of thoſe Days, therefore doth the Holy Ghoſt vouchſafe to allude unto them in Holy Writ. 'Tis a plain miſtake of *Fromondus*, when in Anſwer to theſe Places, he is fain to ſay, that they are uſed proverbially only, and do not poſitively conclude any thing. For when *David* writes theſe Words, that they are *like the deaf Adder which ſtoppeth her ears*, &c. this Affirmation is manifeſtly implied, That the deaf Adder does ſtop her Ears againſt the Voice of the Charmer: Which becauſe it is not true in the Letter of it, (as was ſaid before) therefore 'tis very probable that it ſhould be interpreted in the ſame Senſe wherein here it is cited.

Veſta Trac. 3. cap. 3.

In reference to this alſo, we are to conceive of thoſe other Expreſſions; *Cold cometh out of the North*; *Job* 37. 9. and again, *Fair weather comes out of the North*, *Ver.* 22. So *Ver.* 17. *Thy garments are quieted when he warmeth the Earth by the South Wind.* And *Prov.* 25. 23. *The North Wind driveth away rain.* Which Phraſes do not contain in them any abſolute general Truth, but can ſo far only be verified, as they referred to ſeveral Climates: And though unto us who live on this ſide of the Line, the *North* Wind be coldeſt and drieſt; and on the contrary, the *South* Wind moiſt and warm, by Reaſon that in one in theſe Places there is a ſtronger Heat of the Sun to exhale moiſt Vapours, than in the other; yet it is clean otherwiſe with the Inhabitants beyond the other Tropick; for there the *North* Wind is the hotteſt, and moiſt, and the *South* the coldeſt and dry: So that with them, theſe Scriptures cannot properly be affirmed, that *cold or that fair weather cometh*

out

out of the North; but rather on the contrary. All which notwithstanding, does not in the least manner derogate from the Truth of these Speeches, or the Omnisciency of the Speaker, but do rather shew the Wisdom and Goodness of the Blessed Spirit, in vouchsafing thus to conform his Language unto the Capacity of those People unto whom these Speeches were first directed: In the same sense are we to understand all those places where *the Lights of Heaven* are said to be darkned, *and the Constellations not to give their light*, *Isa.* 13. 10. Not as if they were absolutely in themselves deprived of their Light, and did not shine at all; but because of their Appearance to us; and therefore in another Place answerable to these, God says, *he will cover the Heavens*, and so make the Stars thereof dark, *Ezek.* 37. 2. Which argues, that they themselves were not deprived of this Light (as those other Speeches seem to imply) but we. *Joel* 2. 31. *Item c.* 3. 15.

In reference to this likewise are we to conceive of those other Expressions, that *the Moon shall blush, and the Sun be ashamed*, *Isa.* 24. 23. That *they shall be turned into Blood*, *Matth.* 24. 29. Not that these things shall be so in themselves (saith St. *Jerom*,) but because they shall appear so unto us. Thus also *Mark* 13. 25. *The Stars shall fall from Heaven*; that is, they shall be so wholly covered from our Sight, as if they were quite fallen from their wonted Places. Or if this be understood of their real Fall, as it may seem probable by that Place in the *Revelations*, 6. 13. *And the Stars of Heaven fell unto the Earth, even as a Fig-Tree casteth her untimely Figs, when she is shaken by a mighty Wind*: Then is it to be interpreted not of them that are truly Stars, but them that appear so: Alluding unto the Opinion of the unskilful Vulgar (saith * *Sanctius*) that think the Meteors to be Stars. And † *Mersennus* speaking of the same Scripture, says, *Hoc de veris Stellis minime volunt Interpretes intelligi, sed de Cometis & aliis ignitis Meteoris*: Interpreters do by no means understand this of true Stars, *Comment. in Joel, c.* 3. * *Commen. in Isa. c.* 13. 5. † *Comment. in Gen. c.* 3. *v.* 10. *ar.* 6.

Stars, but of the Comets and other fiery Meteors: Though the falling of theſe be a natural Event, yet may it be accounted a ſtrange Prodigy, as well as an Earthquake, and the darkning of the Sun and Moon, which are mentioned in the Verſe before.

In reference to this, doth the Scripture ſpeak of ſome common natural Effects, as if their true Cauſes were altogether inſcrutable, and not to be found out, becauſe they were generally ſo eſteemed by the Vulgar. Thus of the Wind it is * ſaid, *That none know whence it cometh, nor whither it goeth.* In another † Place God is ſaid *to bring it out of his treaſures*; and ∴ elſewhere it is called *the* * *breath of God*; and ſo likewiſe of the Thunder: Concerning which, † *Job* propoſes this Queſtion, *The Thunder of his Power who can underſtand?* and therefore too ∵ *David* does ſo often ſtile it, *the voice of God.* All which Places ſeem to imply, that the Cauſe of theſe things was not to be diſcovered, which yet later Philoſophers pretend to know: So that according to their Conſtruction, theſe Phraſes are to be underſtood in relation unto their Ignorance unto whom theſe Speeches were immediately directed.

Joh. 3. 8.
† *Jer.* 10. 13.
Item c. 51. 16.
∴ קול
* *Job.* 37. 10.
† *Jo.* 26. 14.
∵ *Pſal.* 2. 9. 3, 4. &c.
Eccleſ. 1. 7.

For this Reaſon is it; Why, though there be in Nature many other Cauſes of Springs and Rivers than the Sea, yet *Solomon* (who was a great Philoſopher, and perhaps not ignorant of them) does mention only this; becauſe moſt obvious, and eaſily apprehended by the Vulgar. Unto all theſe Scriptures, I might add that in *Amos* 5. 8. which ſpeaks of the Conſtellation commonly called the Seven Stars; whereas later Diſcoveries have found that there are but Six of them diſcernable to the bare Eye, as appears by *Galilæus* his Glaſs: The Seventh of them being but a deceit of the Eye, ariſing from their too great nearneſs; and if a Man try in a clear Night to number them diſtinctly, he ſhall find that there will ſometimes appear but Six, and ſometimes more.

Job, 9. 9.
Item 38. 31.
Vide Fromond. Met. l. 3. *c.* 1. *art.* 1.

True indeed, the Original Word of this Scripture כימה,

כימה, does not neceſſarily imply any ſuch Number in its Signification, but yet our *Engliſh* Tranſlation renders it the Seven Stars; and if it had been expreſly ſo in the Original too, it might have ſpoken true enough, becauſe they are uſually eſteemed of that Number. And when it had been ſaid, *He made the Seven Stars and Orion*, we might have eaſily underſtood the Words thus: He made thoſe Conſtellations that are commonly known unto us under ſuch Names.

From all theſe Scriptures 'tis clearly manifeſt, that it is a frequent Cuſtom for the Holy Ghoſt to ſpeak of natural Things, rather according to their Appearance and common Opinion, than the Truth it ſelf. Now it is very plain, and our Enemies themſelves do grant it, that if the World had been framed according to the Syſtem of *Copernicus*, *futurum eſſet ut vulgus, de Solis motu & Terra ſtatu proinde ut nunc loqueretur.* The vulgar Phraſe would have been the ſame as now it is, when it ſpeaks of the Sun's Motion, and the Earth's ſtanding ſtill. *Fromond. Ant. c. 6.*

Wherefore 'tis not improbable, that ſuch kind of Scripture-Expreſſions are to be underſtood only in relation to outward Appearances, and Vulgar Opinion.

PROP. IV.

That divers Learned Men have fallen into great Abſurdities, whilſt they have looked for the Sects of Philoſophy from the Words of Scripture.

IT has been an Ancient and common Opinion amongſt the *Jews*, that the Law of *Moſes* did contain in it, not only thoſe things which concern our Religion and Obedience, but every Secret alſo

that

Schickard. Bechin. Happern. Disp. 5. Num. 8.

that may possibly be known in any Art or Science; so that there is not a Demonstration in Geometry, or Rule in Arithmetick; not a Mystery in any Trade, but it may be found out in the *Pentateuch*. Hence it was (say they) that *Solomon* had all his Wisdom and Policy: Hence it was that he did fetch his Knowledge concerning the Nature of Vegetables, from the Cedar of *Lebanon*, to the Hysop that grows upon the Wall. Nay from hence, they thought a Man might learn the Art of Miracles, to remove a Mountain, or recover the Dead. So strangely have the learneder Sort of that Nation been befooled, since their own Curse hath lighted upon them.

Not much unlike this foolish Superstition of theirs, is that Custom of many Artists amongst us; who upon the Invention of any new Secret, will presently find out some obscure Text or other to father it upon; as if the Holy Ghost must needs take notice of every particular which their partial Fancies did over-value.

Nor are they altogether guiltless of this Fault, who look for any Secrets of Nature from the Words of Scripture; or will examine all its Expressions by the exact Rules of Philosophy.

Unto what strange Absurdities this False Imagination of the Learneder *Jews* hath exposed them, may be manifest by a great multitude of Examples. I will mention only some few of them. Hence it is that they prove the Shin-Bone of *Og* the Giant to be above three Leagues long; or (which is a more modest Relation) that *Moses* being fourteen Cubits in stature, having a Spear ten Ells in length, and leaping up ten Cubits, could touch this Giant but on the Ancle. All which they can confirm unto you by a Cabalistical Interpretation of this Story, as it is set down in Scripture. Hence it is that they tell us of all those strange Beasts which shall be seen at the coming of the Messias: As first, the Ox, which *Job* calls *Behemoth*,

Schickard. ib. Disp. 6. num. 2.

Buxtor. Synag. Juda. c. 36.

moth, that every Day devours the Graſs on a thouſand Mountains, as you may ſee it in the * *Pſalm*, where *David* mentions the Cattel, or בהמות upon a Thouſand Hills. If you ask how this Beaſt does to find Paſture enough, they anſwer, that he remains conſtantly in one place, and where there is as much Graſs grows up in the Night, as was eaten in the Day. * *Pſal.* 50. 10.

They tell us alſo of a Bird, which was of that quantity, that having upon a time caſt an Egg out of her Neſt, there were beaten down by the fall of it Three hundred of the talleſt Cedars, and no leſs than Threeſcore Villages drowned. As alſo of a Frog as big as a Town capable of Sixty Houſes; which Frog, notwithſtanding his greatneſs, was devoured by a Serpent, and that Serpent by a Crow; which Crow, as ſhe was flying up to a Tree, eclipſed the Sun, and darkened the World; by which you may gueſs what a pretty Twig that Tree was. If you would know the Proper Name of this Bird, you may find it in *Pſal.* 50. 11. where it is called זיז, or in our Tranſlation, the Fowl of the Mountains. It ſeems it was ſomewhat of kin to that other Bird they tell us of, whoſe Legs were ſo long, that they reached unto the bottom of that Sea, where there had been an Axe-Head falling for Seven Years together, before it could come to the bottom. *Vide Parap. Chald.*

Many other Relations there are, which contain ſuch horrible Abſurdities, that a Man cannot well conceive how they ſhould proceed from Reaſonable Creatures. And all this ariſing from that wrong Principle of theirs, That Scripture did exactly contain in it all kind of Truths; and that every Meaning was true, which by the Letter of it, or by Cabaliſtical Interpretations might be found out.

Now as it hath been with them, ſo likewiſe hath it happened in proportion unto others, who by a Superſtitious adhering unto the bare Words of Scripture,

have

have expoſed themſelves unto many ſtrange Errors. Thus * St. *Baſil* holds, That next to the Sun, the Moon is bigger than any of the Stars, becauſe *Moſes* does call them only two great Lights.

* *Enarrat. in Gen.*

Thus others maintain, That there are Waters properly ſo called, above the Starry Firmament, becauſe of thoſe Vulgar Expreſſions in Scripture, which in their Literal Senſe do mention them. Of this Opinion were many of the Ancients, *Philo*, *Joſephus*, and ſince them the Fathers, (a) *Juſtin Martyr*, (b) *Theodoret*, (c) *Auſtin*, (d) *Ambroſe*, (e) *Baſil*, and almoſt all the reſt. Since them ſundry other Learned Men, as *Beda*, *Strabo*, *Damaſcen*, *Tho. Aquinas*, *&c.* If you ask for what purpoſe they were placed here, *Juſtin Martyr* tells us, for theſe two ends: Firſt, to cool the Heat that might otherwiſe ariſe from the Motion of the Solid Orbs; and hence it is, ſay they, that *Saturn* is colder than any of the other Planets, becauſe though he move faſter, yet he is nearer to theſe Waters. Secondly, to preſs and keep down the Heavens, leſt the frequency and violence of Winds might break and ſcatter them aſunder: Which Opinion, together with both its Reaſons, are now accounted abſurd and ridiculous.

(a) *Reſponſ. ad queſ.* 93. *Orthod.*
(b) *Que.* 11. *ſup. Gen.*
(c) *De Civ. Dei lib.* 11. *cap. ult.*
(d) *Hexam. l.* 2. *c.* 2.
(e) *Homil.* 3. *in Gen.*

(f) St. *Auſtin* concludes the viſible Stars to be innumerable, becauſe Scripture Phraſes ſeem to imply as much.

(f) *De Civ. Dei, l.* 16. *c.* 23.

That the Heavens are not round, was the Opinion of (g) *Juſtin Martyr*, (h) *Ambroſe*, (i) *Chryſoſtom*, (k) *Theodoret*, (l) *Theophilact*, doubted of by St. *Auſtin* (m), and divers others. Nay, St. *Chryſoſtom* was ſo confident of it, that he propoſes the Queſtion in a triumphant manner: Πῦ εἰσιν οἱ σφαῖραν εἰδῆ ὄρανὸν εἶ ἀποφαινόμενοι. Where are thoſe Men that can prove the Heavens to have a Spherical Form? The Reaſon of which was this, Becauſe 'tis ſaid in one Scripture, *That God ſtretched forth the Heavens as a Curtain*, Pſal. 104. 2. *and ſpreadeth them as a Tent to dwell in*, Iſa. 40. 22. And ſo in that Place of

(g) *Reſpon. adqueſt.* 93.
(h) *Hexam. l.* 1 *c.* 6.
(i) *Homil.* 14. *in Ep. ad Hebr.*
(k) *In c.* 8. *Hebr.*
(l) *In id. c.*
(m) *In Gen. ad lit. l.* 1. *c.* 9. *Item. l.* 2. *c.* 6.

the

the Epiſtle to the *Hebrews*, 8. 2. they are called, *a Tent or Tabernacle:* Which becauſe it is not ſphærical, therefore they conclude alſo, that the Heavens are not of that Form; whereas now, the contrary is as evident as Demonſtration can make a Thing. And therefore, * St. *Jerom* in his time, ſpeaking of the ſame Error, gives it this plain Cenſure: *Eſt in Eccleſia ſtulti loquium, ſi quis Cœlum putet fornicis modo curvatum*, Eſaiæ *quem non intelligit ſermone deceptus.* 'Tis *fooliſh ſpeaking* in the Church, if any through miſapprehenſion of thoſe Words in *Iſaiah*, ſhall affirm the Heavens not to be round.

* *Lib.* 3. *Comment. in Galat. c.* 5.

That the Seas not overflowing the Land is a Miracle, was the Opinion of (a) *Baſil*, (b) *Chryſoſtom*, (c) *Theodoret*, (d) *Ambroſe*, (e) *Nazianzen*, and ſince them, (f) *Aquinas*, (g) *Luther*, *Calvin*, *Marlorate*, with ſundry others: Which they proved from theſe Scripture Expreſſions: That in *Job* 38. 8, 11. *Who hath ſhut up the Sea with Doors, when it brake forth, as if it had iſſued out of the Womb; when I did break up for it my decreed Place; and ſet Bars, and Doors, and ſaid, Hitherto ſhalt thou come, and no further, and here ſhall the Pride of thy Waves be ſtaid.* So likewiſe, *Prov.* 8. 29. *God gave to the Sea his Decree, that the Waters ſhould not paſs his Commandment.* And *Jerem.* 5. 22. *I have placed the Sand for a Bound of the Sea by a perpetual Decree, that they cannot paſs it; and though the Waves thereof toſs themſelves, yet can they not prevail; though they roar, yet can they not paſs over, that they turn not again to cover the Earth.* In all which Places, ſay they, 'tis imply'd, that the Water of it ſelf, were it not withheld from its own natural Inclination by a more ſpecial Power of God, would overflow the Land.

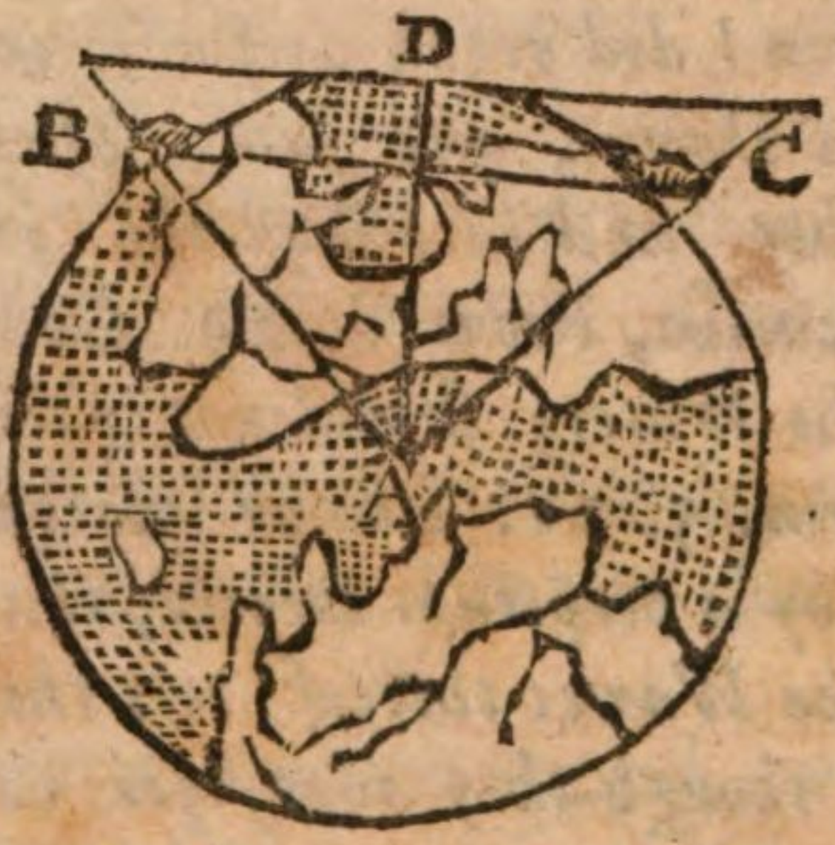
(a) *Homil.* 4. *Hexam.* (b) *Commen. in Job.* (c) *In* Pſal. 103. (d) *Hexam. l.* 3. *c.* 2, 3. (e) *Orat.* 34 (f) *Aquinas part* 1. *queſt.* 69. *art.* 1. (g) *Commen. in* Pſal. 24. *Item in* Pſal. 136. 6.

Others infer the ſame Concluſion from that in *Eccleſiaſtes*, where the Rivers are ſaid to come from the Sea, which they could not do, unleſs that were higher. I anſwer: They ſhould as well conſider the latter part of that Scripture, which ſays, that the Rivers return

to that place from whence they came, and then the force of this Consequence will vanish. To this purpose some urge that Speech of our Saviour, where he bids *Simeon* to launch forth into the Deep; the *Latin* Word is, *in altum*; from whence they gather, that the Sea is higher than the Land. But this savours so much of Monkish Ignorance, that it deserves rather to be laughed at, than to be answered.

Luke 5, 4. Εἰς τὸ βάθος.

But now if we consider the true Properties of this Element, according to the Rules of Philosophy, we shall find, that its not overflowing the Land is so far from being a Miracle, that it is a necessary Consequence of its Nature; and 'twould rather be a Miracle, if it should be otherwise, as it was in the General Deluge. The Reason is, because the Water of it self must necessarily descend to the lowest place; which it cannot do, unless it be collected in a Sphærical Form, as you may plainly discern in this Figure.



Where the Sea at *D*, may seem to be higher than a Mountain at *B*, or *C*, because the rising of it in the midst, does so intercept our Sight from either of those Places, that we cannot look in a Strait Line, from the one to the other. So that it may seem to be no less than a Miracle, by which the Sea (being a heavy Body) was withheld from flowing down to those lower Places of *B*, or *C*. But now, if you consider that

the

the ascending of a Body is its Motion from the Centre, and descent is its approaching unto it; you shall find, that for the Sea to move from *D*, to *B* or *C*, is a Motion of Ascent, which is contrary to its Nature, because the Mountains at *B*, or *C*, are farther off from the Centre, than the Sea at *D*; the Lines *A B*, and *A C*, being longer than the other *A D*. So that for the Sea to keep always in its Channel, is but agreeable to its Nature, as being a heavy Body. But the meaning of those Scriptures is, to set forth the Power and Wisdom of God; who hath appointed these Channels for it, and beset it with such strong Banks to withstand the fury of its Waves. Or if these Men do so much rely in Natural Points, upon the bare Words of Scripture, they might easily be confuted from those other Places, where God is said to have founded the Earth upon the Seas, and establish'd it upon the Floods. From the Literal Interpretation of which, many of the Ancients have fallen into another Error; affirming the Water to be in the lower place; and as a *Basis*, whereon the weight of the Earth was born up. Of this Opinion were * *Clemens Alexandrinus*, † *Athanasius*, ∴ *Hillary*, * *Eusebius*, and others. So that it seems, if a Man should resolutely adhere to the bare Words of the Scripture, he might find Contradiction in it; of which the Natural Meaning is altogether incapable. † St. *Jerom* tells us of some who would prove Stars to have Understanding, from that place in *Isaiah*, 45, 12. *My Hands have stretched out the Heavens, and all their Host have I commanded.* Now (say they) none but Intelligent Creatures are capable of Precepts; and therefore the Stars must needs have Rational Souls. Of this Opinion was † *Philo* the *Jew*: Nay, many of the Rabbies conclude, that they do every Hour sing Praises unto God with an audible real Voice; because of that in *Job* 38. 7. which speaks of *the Morning Stars singing together*. And *Psal.* 19. 3, 4. where 'tis said of the Heavens, That

* *Recog.* 8.
† *Orat. cont. Idolos.*
∴ *In* Psal. 136. 6.
* *In* Psal. 24.
† *Comment. in* Isa. *l.* 13.

† *Deplant. Noe.*
Tostatus in Josh. c. 10. *quest.* 13, 14.

there is no Speech nor Language where their Voice is not heard, and their Words are gone to the ends of the World. And whereas we tranſlate that Place in the Tenth of *Joſhua*, concerning the ſtanding ſtill of the Heavens; the original Word, דמם does properly ſignifie Silence, and according to their Opinion, *Joſhua* did only bid them hold their peace. From ſuch grounds 'tis likely did * *Origen* fetch his Opinion, that the Stars ſhould be ſaved. I might ſet down many other the like Inſtances, were it not for being already weary of raking into the Errors of Antiquity, or uncovering the Nakedneſs of our Forefathers. That Excuſe of † *Acoſta* may juſtly ſerve to mitigate the Miſtakes of theſe Ancient Divines: *Facilè condonandum eſt patribus, ſi cum cognoſcendo colendóque Creatori toti vacarent, de Creaturâ minus aptè aliqua ex parte opinati ſunt.* Thoſe Good Men were ſo wholly buſied about the Knowledge and Worſhip of the Creator, that they had not leiſure enough for an Exact Search into the Eſſence of the Creatures. However, theſe Examples that have been already cited, may ſufficiently manifeſt how frequently others have been deceived, in concluding the Points of Philoſophy from the Expreſſions of Scripture. And therefore 'tis not certain, but that in the preſent Caſe alſo, it may be inſufficient for ſuch a manner of Arguing.

* *Tom.* 1. *in Johan.*

† *De nat. novi orbis, l.* 1. *c.* 2.

PROP. V.

That the Scripture, in it Proper Conſtruction, does not any where affirm the Immobility of the Earth.

THE ſame Anſwer which was inſiſted on before, concerning the Conformity of Scripture Expreſſions to Mens Capacity and Common Opinion, may well

well enough ſatisfy all thoſe other Arguments, which ſeem thence to affirm the Earth's Settledneſs and Immobility; ſince this is as well agreeable to outward appearance and vulgar apprehenſion as the other. But now for more full ſatisfaction, I ſhall ſet down the Particular Places that are urged for it; which being throughly examined, we may plainly diſcern that none of them, in their proper Meaning, will ſerve to infer any ſuch Concluſion.

One of theſe Sayings is that of the Preacher, *Eccleſ.* 1. 4. *One Generation cometh, and another paſſeth, but the Earth endureth for ever*; where the Original Word is, עמד, and the Vulgar, *Stat*; from whence our * Adverſaries conclude that it is immovable.

I anſwer: The Meaning of the Word, as it is here apply'd, is *permanent*; or as we tranſlate it, *endureth*. For it is not the purpoſe of this Place to deny all kind of Motion to the whole Earth, but that of Generation and Corruption, to which other things in it are liable. And though *Pineda*, and others keep a great deal of impertinent ſtir about this Scripture, yet they grant this to be the natural Meaning of it: Which you may more clearly diſcern, if you conſider the chief Scope of this Book; wherein the Preacher's Intent is, to ſhew the extraordinary Vanity of all Earthly Contentments, *ver.* 2. the utter Unprofitableneſs of all a Man's Labour, *ver.* 3. and this he illuſtrates by the ſhortneſs and uncertainty of his Life, in which reſpect he is below many of his Fellow Creatures, as may be manifeſted from theſe four Compariſons.

* *Valleſius Sacra Phil. c.* 62. *Fuller, Miſcell. l.* 1. *c.* 15. *Pineda Comment. in locum.*

1. From the Earth, which though it ſeem to be but as the Sediment of the World, as the Rubbiſh of the Creation; yet is this better than Man in reſpect of his laſtingneſs; for *one Generation paſſeth away, and another cometh*; *but the Earth* that abideth for ever, *v.* 4.

2. From the Sun; who though he ſeem frequently to go down, yet he conſtantly ſeems to riſe again, and ſhines with the ſame Glory, *v.* 5. *But Man dieth, and waſteth away, yea, Man giveth up the Ghoſt, and where is he? he lieth down, and riſeth not till the Heavens be no more.*

Job 14. 10, 12.

3. From the Wind, the Common Emblem of Uncertainty; yet it is more conſtant than Man, for that *knows its Circuits, and whirleth about continually*, v. 6. *Whereas our Life paſſeth away as doth the Wind, but returneth not again.*

Pſal. 78. 39.

4. From the Sea; though it be as uncertain as the Moon, by whom 'tis governed, yet is it more durable than Man and his Happineſs. For though the Rivers run into it, and from it, yet is it ſtill of the ſame quantity that it was at the beginning, *v.* 7. But Man grows worſer as he grows older, and ſtill nearer to a decay. So that in this reſpect he is much inferior to many other of his Fellow Creatures.

From whence it is manifeſt, that this Conſtancy, or Standing of the Earth is not oppoſed to its Local Motion, but to the changing or paſſing away of divers Men in their ſeveral Generations. And therefore thence to conclude the Earth's Immobility were as weak and ridiculous as if one ſhould argue thus: One Miller goes, and another comes, but the Mill remains ſtill; *ergo*, the Mill hath no Motion.

Mr. Carpenter's *Geog. l.* 1. *c.* 4.

Or thus: One Pilate goes, and another comes, but the Ship remains ſtill; *ergo*, the Ship doth not ſtir.

* *Perplex. l.* 2. *c.* 29.

* *R. Moſes* tells us, how that many of the *Jews* did from this place conclude, that *Solomon* thought the Earth to be Eternal, becauſe he ſaith it abideth לעולם for ever; and queſtionleſs, if we examine it impartially, we ſhall find that the Phraſe ſeems more to favour this Abſurdity, than that which our Adverſaries would collect from hence, that it is without Motion.

But

But Mr. *Fuller* urging this Text againſt *Copernicus*; tells us, if any ſhould interpret theſe Phraſes concerning the Earth's ſtanding ſtill, *v.* 4. and the Sun's Motion, *v.* 5. in reference only to Appearance, and Common Opinion; he muſt neceſſarily alſo underſtand thoſe two other Verſes which mention the Motion of the Wind and Rivers in the ſame Senſe. As if he ſhould ſay; Becauſe ſome things appear otherwiſe than they are, therefore every thing is otherwiſe than it appears: Or, Becauſe Scripture ſpeaks of ſome Natural Things, as they are eſteem'd according to Man's Falſe Conceit, therefore 'tis neceſſary that every Natural Thing mention'd in Scripture muſt be interpreted in the like Senſe: Or, becauſe in one place we read of the Ends of a Staff, 1 *Kings* 8. 8. and in many other places of the Ends of the Earth, and the Ends of Heaven; therefore the Earth and Heavens have as properly Ends as a Staff. 'Tis the very ſame Conſequence of that in the Objection. Becauſe in this place of *Eccleſiaſtes* we read with the Reſt of the Earth, and the Motion of the Sun; therefore theſe Phraſes muſt needs be underſtood in the ſame proper Conſtruction as thoſe afterwards, where Motion was attributed to the Wind and Rivers. Which Inference you ſee is ſo weak, that the Objector need not triumph ſo much in its ſtrength as he doth.

Another Proof like unto this is taken from St. *Peter*, *Epiſt.* 2. *cap.* 3. *ver.* 5. where he ſpeaks of the Earth ſtanding out of the Water, and in the Water, συνεστῶσα, and therefore the Earth is immovable.

I anſwer: 'Tis evident that the Word here is equivalent with *fuit*; and the Scope of the Apoſtle is to ſhew, that God made all the Earth, both that which was above the Water, and that which was under it. So that from this Expreſſion, to collect the Reſt and Immobility of the Earth, would be ſuch an Argument as this other. Such a Man made that part of a Mill-Wheel, or a Ship, which ſtands below the Water, and

that part which ſtands above the Water; therefore thoſe Things are immovable.

To ſuch vain and idle Conſequences does the Heat of Oppoſition drive our Adverſaries.

A Third Argument ſtronger than either of the former, they conceive may be collected from thoſe *Scriptures; where 'tis ſaid, *The World is eſtabliſhed, that it cannot be moved.*

* 1 *Chron.* 16. 30. *Pſal.* 93. 1. *Item* 96. 10.

To which I anſwer: Theſe Places ſpeak of the World in general, and not particularly of our Earth; and therefore may as well prove the Immobility of the Heavens, they being the greateſt part of the World; in compariſon to which, our Earth is but as an inſenſible point.

If you reply, that the Word in theſe Places is to be underſtood by a *Synechdoche*, as being meant only of this Habitable World, the Earth:

I anſwer: Firſt, this is only ſaid, not proved: Secondly, *David* but a little before ſeems to make a difference between the World and the Earth, *Pſal.* 90. 2. where he ſays, *Before thou hadſt formed the Earth and the World.* But Thirdly, in another Place there is the ſame Original Word apply'd expreſly to the Heavens; and which is yet more, the ſame Place does likewiſe mention this ſuppoſed Settledneſs of the Earth, *Prov.* 3. 19. *The Lord by Wiſdom hath founded the Earth; and by Underſtanding hath he eſtabliſhed the Heavens.* So that theſe Places can no more prove an Immobility in the Earth than in the Heavens.

If you yet reply, That by the Heavens there is meant the Seat of the Bleſſed, which does not move with the reſt:

I anſwer: Though by ſuch an Evaſion a Man might poſſibly avoid the force of this Place; yet, Firſt, 'tis but a groundleſs ſhift, becauſe then that Verſe will not contain a full enumeration of the Parts in the World, as may ſeem more agreeable to the Intention of it; but only ſhew, that God created this Earth where we

live,

live, and the Heaven of Heavens. So that the Heaven of the Stars and Planets ſhall be ſhifted out from the number of the other Creatures. Secondly, there is another place which cannot be ſo avoided, *Pſal.* 89. 37. where the Pſalmiſt uſes this Expreſſion, יכון *It ſhall be eſtabliſhed as the Moon.* So *Pſal.* 8. 4. *The Moon and the Stars,* כוננתה אשר *which thou haſt eſtabliſhed.* Thus likewiſe, *Prov.* 8. 27. *when he eſtabliſhed the Heavens:* And in the next Verſe, our *Engliſh* Tranſlation reads it, *when he eſtabliſhed the Clouds.* And yet our Adverſaries will affirm the Moon, and Stars, and Clouds to be ſubject unto Natural Motions: Why then ſhould the very ſame Expreſſions be counted as ſufficient Arguments to take it away from the Earth?

If it be replied, That by eſtabliſhing the Heavens, is meant only the holding of them up, that they do not fall down to us (as *Lorinus* explains that in the Eighth *Pſalm*, and quotes *Euthymius* for the ſame Interpretation;) *fundandi verbum ſignificat decidere non poſſe, aut dimoveri a loco ubi collocata ſunt.* I anſwer, why may not we as well interpret the Words thus of the Earth; ſo that by eſtabliſhing of it, is meant only the keeping of it up in the vaſt Places of the open Air, without falling to any other Place. *Lorinus Comment. in Pſal.* 8.

From hence it is plain, That theſe Scriptures are to be underſtood of ſuch an Immobility in the Earth, as may likewiſe agree with the Heavens: The ſame Original Word being ſo promiſcuouſly applied to both.

Ay, but (you will ſay) there are ſome other Places which do more peculiarly apply this Settledneſs and Eſtabliſhment to the Earth. So *Pſal.* 119. 90. *Thy faithfulneſs is unto all generations: Thou haſt eſtabliſhed the Earth, and it abideth.* Thus likewiſe, *Pſal.* 104. 5. *Who laid the foundations of the Earth, that it ſhould not be removed for ever.* The latter of which, being well weighed in its Original (ſaith Mr. *Fuller*) does in three Em- *Miſcel. l.* 1. *cap.* 15.

Emphatical Words ſtrongly conclude the Earth's Immobility.

As Firſt, when he ſays יסד *fundavit*, he hath founded it; wherein it is implied, that it does not change his Place. To which may be added all thoſe Texts, which ſo frequently ſpeak of *the foundations of the Earth*; as alſo that Expreſſion of the *Pſalmiſt*, where he mentions *the Pillars of the Earth*, *Pſal.* 75. 3.

The Second Word is מכון transſated *Baſis*; and by the *Septuagint*, ἐπὶ τῷ ἀσφάλειαν αὐτῆς; that is, he hath founded it upon its own Firmneſs; and therefore it is altogether without Motion.

The Third Expreſſion is בל-תמוט from the Root מוט which ſignifies, *declinare*; implying, that it could not wag with the leaſt kind of Declination.

To theſe I anſwer ſeverally:

Firſt, for the word, יסד *fundavit*, it cannot be underſtood properly, as if the natural Frame of the Earth, like other artificial Buildings, did need any Bottom to uphold it; for *he hangeth the earth upon nothing*, *Job* 26. 7. But it is a *Metaphor*, and ſignifies God's placing or ſituating this Globe of Land and Water. As *David* tells us of *the Pillars of the earth*; ſo *Job* mentions *Pillars of the Heavens*, *Job* 26. 11. And yet that will not prove them to be immoveable.

True indeed, we read often concerning the Foundations of the Earth: But ſo we do likewiſe of the Ends, Sides, and Corners of the Earth; and yet theſe Scriptures will not prove it to be of a long or ſquare Form. Beſides, we read alſo of the Foundations of Heaven, מוסדות 2 *Sam.* 22. 8. And yet we muſt not hence infer, that they are without all Motion: As alſo of the *planting of the Heavens*, *Iſa.* 51. 6. which may as well prove them to be immoveable, as that which follows in the ſame Verſe concerning the Foundations of the Earth.

Which Phraſe (if I have obſerved right) in ſeveral Places of Scripture, is to be underſtood according to theſe three Interpretations.

1. It

1. It is taken ſometimes for the lower Parts of the Earth, as appears by that Place, 2 *Sam.* 22. 16. *The channels of the Sea appeared, the foundations of the World were diſcovered.* So *Pſal.* 18. 15.

2. Sometimes for the Beginning and firſt Creation of it. *Iſa.* 40. 2. *Hath it not been told you from the beginning, have ye not underſtood from the foundations of the Earth?* And in many other Places, *Before the Foundations of the World was laid*; that is, before the firſt Creation. Joh. 17. 24. Epheſ. 1 4.

3. Sometimes it ſignifies the Magiſtrates and chief Governors of the Earth. So, many interpret that Place in *Micah*, where 'tis ſaid, 6. 2. *Hear O ye mountains the Lord's controverſy, and ye ſtrong foundations of the Earth.* So *Pſal.* 82. 5. *The foundations of the Earth are out of courſe*; and in *Sam.* 2. 8. They are called Pillars. *For the Pillars of the Earth are the Lords, and he hath ſet the World upon them.* Hence it is, that the *Hebrews* derive their Word for Maſter, or Lord, from a Root which ſignifies a *Baſis* or Bottom. אדון, *ab* אדן. And the *Greek* Word for King, does in its Primitives import as much as the Foundation of the People, βάσιλεὺς, *quaſi* βάσις τοῦ λαοῦ. But now, none of all the ſeveral Interpretations of this Phraſe, will in the leaſt manner conduce to the Confirmation of the preſent Argument. *Etimol. mag.*

As for the Second Word, מכונתה *Baſis ejus*: I anſwer, the proper Signification of it, is *locus diſpoſitus*, *ſedes*, or *ſtatio*, an appointed Seat or Station; and according to this Senſe, is it moſt frequently uſed in Scripture. And therefore, the Heavens are ſometimes called מכון the Seat of God's Habitation. And for this Reaſon likewiſe, do *Aquila* and *Symmachus* tranſlate it by the Word ἕδρα, a Seat or appointed Situation, which may as well be attributed to the Heavens.

The Third Expreſſion is בל תמוט, that it ſhould not be moved, from the Primitive מוט, which does not ſignifie barely to move, but *declinare*, or *vacillare*, to decline or ſlip aſide from its uſual Courſe. Thus is it

uſed

uſed by *David*, *Pſal.* 17. 5. where he prays, *Hold up my goings in thy paths,* בל נמטו פעמי *That my footſteps ſlide not*: He does not mean that his Feet ſhould not move. So *Pſal.* 121. 3. *He will not ſuffer thy foot to be moved.* Thus likewiſe, *Pſal.* 16. 8. *Becauſe the Lord is at my right hand, I ſhall not be moved.* Which laſt Place is tranſlated in the New Teſtament by the *Greek* Word σαλεύω, which ſignifies *fluctuare*, or *vacillare*, to be ſhaken by ſuch an uncertain Motion as the Waves of the Sea. Now as *David's* Feet may have their uſual Motion, and yet in this Senſe be ſaid not to move, that is, not to decline or ſlip aſide; ſo neither can the ſame Phraſe applied to the Earth, prove it to be immoveable.

Act. 2. 25.

Comment. in Job.

Nor do I ſee any Reaſon, why that of *Didacus Aſtunica* may not be truly affirmed, That we may prove the natural Motion of the Earth, from that Place in *Job* 9. 6. *Qui commovet terram e loco ſuo*, as well as its Reſt and Immobility from theſe.

From all which, it is very evident, that each of theſe Expreſſions, concerning the founding or eſtabliſhing both of Heaven or Earth, were not intended to ſhew the Unmoveableneſs of either; but rather, to manifeſt the Power and Wiſdom of Providence, who had ſo ſettled theſe Parts of the World in their proper Situations, that no natural Cauſe could diſplace them, or make them decilne from their appointed Courſe. As for ſuch who do utterly diſlike all new Interpretation of Scripture, even in ſuch Matters as do meerly concern Opinion, and are not fundamental, I would only propoſe unto them a Speech of St. *Hierom*, concerning ſome that were of the ſame Mind in his Time. *Cum novas ſemper expetant voluptates, & gulæ eorum vicina Maria non ſufficiant, cur in ſolo ſtudio Scripturarum, veteri ſapore contenti ſunt.*

Thus have I in ſome meaſure cleared the chief Arguments from Scripture, againſt this Opinion. For which notwithſtanding, I have not thence cited any; be-

becauſe I conceive the Holy Writ, being chiefly intended to inform us of ſuch things as concern our Faith and Obedience, we cannot thence take any proper Proof for the Confirmation of Natural Secrets.

PROP. VI.

That there is not any Argument from the Words of Scripture, Principles of Nature, or Obſervations in Aſtronomy, which can ſufficiently evidence the Earth to be in the Centre of the Univerſe.

OUR Adverſaries do much inſult in the ſtrength of thoſe Arguments which they conceive do unanſwerably conclude the Earth to be in the Centre of the World. Whereas, if they were but impartially conſidered, they would be found altogether inſufficient for any ſuch Concluſion, as ſhall be clearly manifeſted in this following Chapter.

The Arguments which they urge in the Proof of this, are of Three ſorts; Either ſuch as are taken,

1. From Expreſſions of Scripture.
2. From Principles of Natural Philoſophy.
3. From common Appearances in Aſtronomy.

Thoſe of the firſt kind are chiefly Two: The firſt is grounded on that common Scripture-Phraſe, which ſpeaks of the Sun, as being above us. So *Solomon* often mentioning human Affairs, calls them, *the works which are done under the Sun.* From whence it appears, that the Earth is below it, and therefore nearer to the Centre of the *Univerſe*, than the Sun. *Eccleſ.* 1. 14, &c.

I anſwer: Though the Sun in compariſon to the abſolute Frame of the World, be in the midſt; yet this does not hinder, but that in reſpect to our Earth, he may be truly ſaid to be above it; becauſe we uſually meaſure

measure the height or lowneſs of every thing, by its being further off, or nearer unto this Centre of our Earth. From which, ſince the Sun is ſo remote, it may properly be affirmed that we are under it, though notwithſtanding that be in the Centre of the World.

A ſecond Argument of the ſame kind, is urged by *Fromondus.*

Antar. c. 12. item Veſta. tract. 5. c. 2.

'Tis requiſite, that Hell (which is in the Center of the Earth) ſhould be moſt remotely ſituated from the Seat of the Bleſſed. But now this Heaven, which is the Seat of the Bleſſed, is Concentrical to the Starry Sphere: And therefore it will follow, that our Earth muſt be in the midſt of this Sphere; and ſo conſequently in the Center of the World.

I anſwer: This Argument is grounded upon theſe Uncertainties;

1. That Hell muſt needs be ſituated in the Center of our Earth.

2. That the Heaven of the Bleſſed muſt needs be Concentrical to that of the Stars.

3. That Places muſt be as far diſtant in Situation as in Uſe.

Which becauſe they are taken for granted, without any Proof, and are in themſelves but weak and doubtful; therefore the Concluſion (which always follows the worſer part) cannot be ſtrong, and ſo will not need any other Anſwer.

The ſecond ſort of Arguments taken from Natural Philoſophy, are principally theſe Three.

Arg. 1. 1. Firſt, from the Vileneſs of our Earth, becauſe it conſiſts of a more ſordid and baſe Matter than any other part of the World; and therefore muſt be ſituated in the Center, which is the worſt place, and at the greateſt diſtance from thoſe purer incorruptible Bodies, the Heavens.

I anſwer: This Argument does ſuppoſe ſuch Propoſitions for Grounds, which are not yet proved, and therefore not to be granted. As, 1. That

1. That Bodies muſt be as far diſtant in Places, as in Nobility.

2. That the Earth is of a more ignoble Subſtance than any of the other Planets, conſiſting of a more baſe and vile Matter.

3. That the Center is the worſt Place.

All which are (if not evidently falſe) yet very uncertain.

2. From the Nature of the Center, which is the place of Reſt, and ſuch as in all Circular Motions is its ſelf immovable, and therefore will be the fitteſt Situation for the Earth; which by reaſon of its heavineſs, is naturally unfit for Motion. *Arg.* 2.

I anſwer: This Argument likewiſe is grounded upon theſe Two falſe Foundations; As,

1. That the whole Frame of Nature does move round, excepting only the Earth.

2. That the whole Earth, conſidered as whole, and in its proper Place, is heavy, or more unfit for a Natural Motion, than any of the other Planets.

Which are ſo far from being ſuch general Grounds from which Controverſies ſhould be diſcuſſed, that they are the very thing in Queſtion betwixt us and our Adverſaries.

3. From the Nature of all heavy Bodies, which is to fall towards the loweſt Place. From whence they conclude, that our Earth muſt be in the Center. *Arg.* 3.

I anſwer: This may prove it to be a Center of Gravity, but not of Diſtance, or that it is in the midſt of the World. Yea, (but ſay our Adverſaries) *Ariſtotle* for this urges a Demonſtration, which muſt needs be infallible. Thus the Motion of light Bodies does apparently tend upward towards the Circumference of the World: But now the Motion of heavy Bodies is directly contrary to the aſcent of the other; wherefore it will neceſſarily follow, that theſe do all of them tend unto the Center of the World.

I an-

I anſwer: Though *Ariſtotle* were a Maſter in the Art of *Syllogiſms*, and he from whom we received the Rules of Diſputation; yet in this Particular, 'tis very plain that he was deceived with a Fallacy, whilſt his Argument does ſuppoſe that which it does pretend to prove.

That light Bodies do aſcend unto ſome Circumference which is higher and above the Earth, is plain and undeniable. But that this Circumference is the ſame with that of the World, or Concentrical unto it, cannot be reaſonably affirmed, unleſs he ſuppoſe the Earth to be in the Center of the *Univerſe*, which is the thing to be proved.

I would fain know from what Grounds our Adverſaries can prove, that the Deſcent of heavy Bodies is to the Center; or the Aſcent of light Bodies, to the Circumference of the World. The utmoſt Experience we can have in this kind, does but extend to thoſe things that are upon our Earth, or in the Air above it. And alas! what is this unto the vaſt Frame of the whole *Univerſe*, but *punctulum*, ſuch an inſenſible Point, which does not bear ſo great a proportion to the whole, as a ſmall Sand does unto the Earth. Wherefore it were a ſenſeleſs thing, from our Experience of ſo little a part, to pronounce any thing infallibly concerning the Situation of the whole. The Arguments from *Aſtronomy*, are chiefly theſe Four; each of which are boaſted of to be unanſwerable.

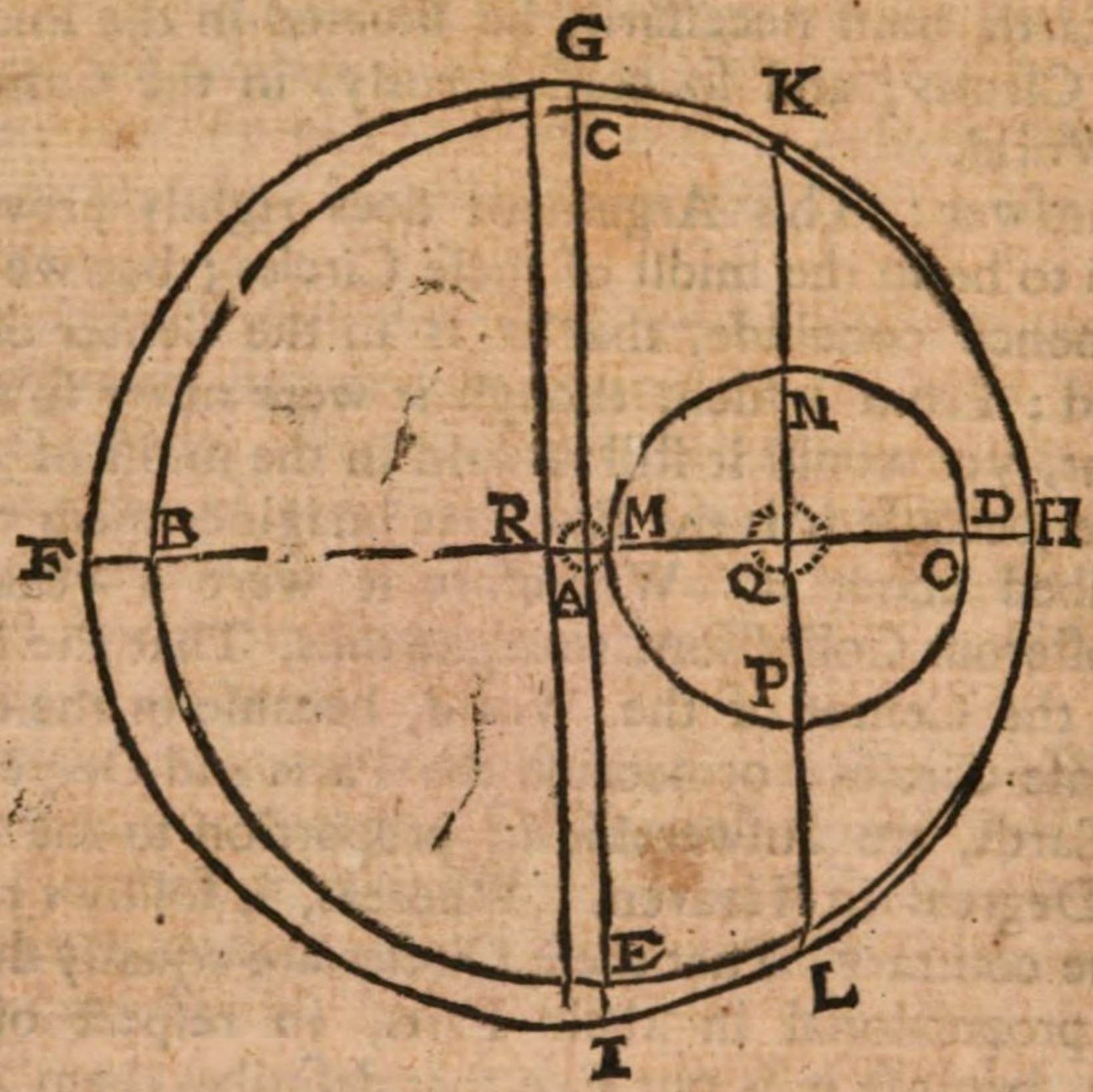
Arg. 1. 1. The *Horizon* does every where divide all the great Circles of a Sphere into two equal Parts; ſo there is always half the Equinoctial above it, and half below. Thus likewiſe, there will conſtantly be ſix Signs of the *Zodiack* above the *Horizon*, and other ſix below it. And beſides, the Circles of the Heaven and Earth, are each way proportionable to one another; as Fifteen *German* Miles on the Earth, are every where agreeable to one Degree in the Heavens; and one Hour in the Earth, is correſpondent to Fifteen Degrees in

the

he *Equator*. From whence it may be inferred, that the Earth muſt neceſſarily be ſituated in the midſt of theſe Circles; and ſo conſequently, in the Center of the World.

I anſwer: This Argument does rightly prove the Earth to be in the midſt of theſe Circles; but we cannot hence conclude, that it is in the Center of the World: From which, though it were never ſo much diſtant, yet would it ſtill remain in the midſt of thoſe Circles, becauſe it is the Eye that imagines them to be deſcribed about it. Wherefore it were a weak and prepoſterous Collection, to argue thus, That the Earth is in the Center of the World, becauſe in the midſt of thoſe Circles; or becauſe the Parts and Degrees of the Earth, are anſwerable in proportion to the Parts and Degrees in Heaven. Whereas, it follows rather on the contrary, That theſe Circles are equally diſtant and proportional in their Parts, in reſpect of the Earth, becauſe it is our Eye that deſcribes them about the Center of it.

So that though a far greater part of the World did appear at one time than at another, yet in reſpect of thoſe Circles which our Eye deſcribes about the Earth, all that we could ſee at once, would ſeem to be but a perfect Hemiſphere; as may be manifeſted by this following Figure.



Where if we ſuppoſe *A* to be our Earth, *B C D E* one of the great Circles which we fancy about it, *F G H I* the Orb of fixed Stars, *R* the Center of them: Now though the Ark *G F I* be bigger than the other *G H I*, yet notwithſtanding, to the Eye on the Earth *A*, one will appear a Semicircle as well as the other; becauſe the Imagination does transfer all thoſe Stars into the leſſer Circle *B C D E*, which it does fancy to be deſcribed above that Center. Nay, tho' there were a habitable Earth at a far greater diſtance from the Center of the World, even in the place of *Jupiter*, as ſuppoſe at *Q*; yet then alſo would there be the ſame Appearance. For though the Ark *K F L* in the Starry Heaven, were twice as big as the other *K H L*, yet notwithſtanding at the Earth *Q* they would both appear but as equal Hemiſpheres, being transferred into that other Circle *M N O P*, which is part of the Sphere that the Eye deſcribes to it ſelf about that Earth.

From

From whence we may plainly discern, That though the Earth be never so far distant from the Center of the World, yet the Parts and Degrees of that imaginary Sphere about it, will always be proportional to the Parts and Degrees of the Earth.

2. Another Demonstration like unto this former, frequently urged to the same purpose, is this. If the Earth be out of the Center of the World, then must it be situated in one of these Three Positions: Either in the *Equator*, but out of the *Axis*; or 2*dly*, in the *Axis*, but out of the *Equator*; or 3*dly*, besides both of them. But it is not placed according to any of these Situations, therefore must it needs be in the Center. *Arg.* 2. *Vid. Carp. Geog. l.* 1. *c.* 5.

1. 'Tis not in the *Equator*, and beside the *Axis*: For then, 1*st*, there will be no *Equinox* at all in some Places, when the Days and Nights shall be of an equal length; 2*dly*, the Afternoons and Forenoons will not be of the same length; because, then our Meridian Line must divide the *Hemisphere* into unequal Parts.

2. 'Tis not in the *Axis*, but out of the *Equator*; for then, first, the *Equinox* would not happen when the Sun was in the middle Line betwixt the two *Solstices*, but in some other Parallel, which might be nearer to one of them, according as the Earth did approach to one *Tropick* more than another. Secondly, there would not be such a proportion between the increase and decrease of Days and Nights, as now there is.

3. 'Tis not besides both of them: For then, all these Inconveniencies, and sundry others must with the same necessity of Consequence be inferred. From whence it will follow, That the Earth must be situated there where the *Axis* and *Equator* meet, which is in the Center of the World.

To this we grant, that the Earth must needs be placed both in the *Axis* and *Equator*; and so consequently, in the Center of that Sphere which we imagine about it. But yet this will not prove, that it is in the

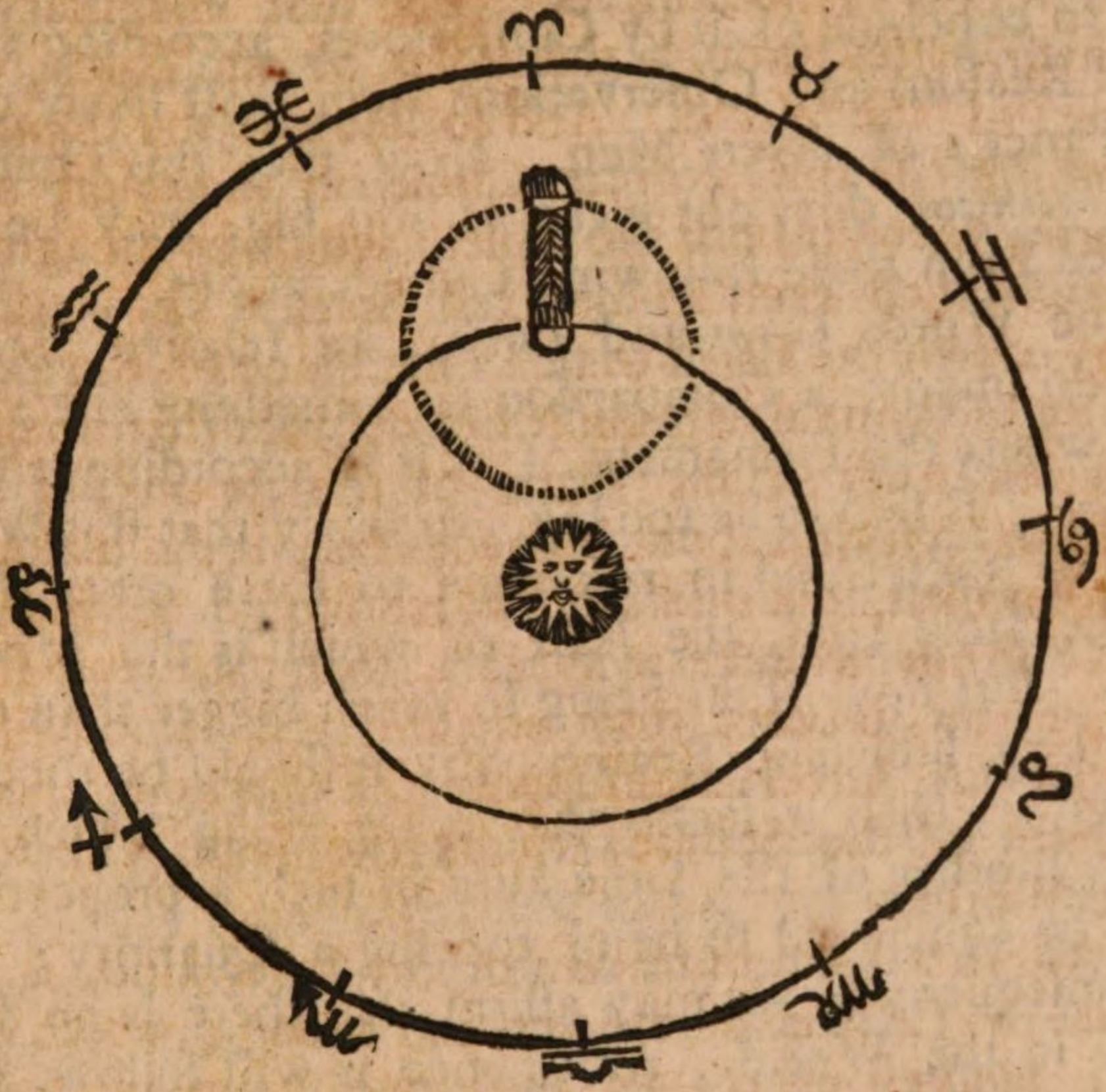
midſt of the *Univerſe*: For let our Adverſaries ſuppoſe it to be as far diſtant from that, as they conceive the Sun to be; yet may it ſtill be ſituated in the very Concourſe of theſe two Lines; becauſe the *Axis* of the World is nothing elſe, but that imaginary Line which paſſes through the Poles of our Earth, to the Poles of the World. And ſo likewiſe the *Equator* is nothing elſe but a great Circle in the midſt of the Earth, betwixt both the Poles, which by Imagination is continued even to the fixed Stars. Thus alſo, we may affirm the Earth to be in the Plane of the *Zodiack*, if by its Annual Motion it did deſcribe that imaginary Circle: And in the Plane of the *Equator*, if by its Diurnal Motion about its own *Axis*, it did make ſeveral Parallels, the midſt of which ſhould be the *Equator*. From whence it appears, that theſe two former Arguments proceed from one and the ſame Miſtake; whilſt our Adverſaries ſuppoſe the Circumference and Center of the Sphere, to be the ſame with that of the World.

Arg. 3. Another Demonſtration of the ſame kind, is taken from the Eclipſes of the Sun and Moon; which would not always happen when theſe two Luminaries are Diametrically oppoſed, but ſometimes when they are leſs diſtant than a Semicircle, if it were ſo that the Earth were not in the Center.

I anſwer: This Argument, if well conſidered, will be found moſt directly to infer this Concluſion; That in all Eclipſes, the Earth is in ſuch a ſtrait Line (betwixt the two Luminaries) whoſe Extremities do point unto oppoſite parts of the *Zodiack*. Now, tho' our Adverſaries ſhould ſuppoſe (as *Copernicus* does) the Earth to be ſituated in that which they would have to be the Sun's Orb; yet would there not be any Eclipſe, but when the Sun and Moon were Diametrically oppoſite, and our Earth betwixt them; as may clearly be manifeſted by this Figure, where you ſee the two Luminaries in oppoſite Signs: And according as any

part

part of our Earth is ſituated by its Diurnal Revolution, ſo will every Eclipſe be either viſible, or not viſible unto it.



The laſt and chief Argument, is taken from the appearance of the Stars; which in every Horizon, at each Hour of the Night, and at all times of the Year, ſeem of an equal bigneſs. Now this could not be, if our Earth were ſometimes nearer unto them by 2000000 *German* Miles, which is granted to be the Diameter of that Orb wherein the Earth is ſuppoſed to move.

Arg. 4. *Ariſt. de cælo. lib.* 2. *c.* 14.

I anſwer: This Conſequence will not hold, if we affirm the Earth's Orb not to be big enough for the making of any ſenſible difference in the appearance of the fixed Stars.

Yea, but (you will ſay) 'tis beyond Conceit, and without all Reaſon, to think the fixed Stars of ſo vaſt a diſtance from us, that our approaching nearer unto them

Copern. l 1. *cap.* 5, 6.

them by 2000000 *German* Miles, cannot make any difference in the ſeeming Quantity of their Bodies.

I reply: There is no certain way to find out the exact diſtance of the Starry Firmament; but we are fain to conclude of it by Conjectures, according as ſeveral Reaſons and Obſervations ſeem moſt likely unto the Fancies of divers Men. Now that this Opinion of *Copernicus* does not make it too big, may be diſcerned from theſe following Conſiderations.

The Words *Great* and *Little*, are relative Terms, and do import a Compariſon to ſomething elſe: So that where the Firmament, (as it is according to *Copernicus*) is ſaid to be too big, 'tis likely that this Word is to be underſtood in reference to ſome other thing of the ſame kind, the leaſt of which is the Moon's Orb. But now if its being ſo much bigger than this, may be a ſufficient Reaſon why it ſhould be thought too great, then it ſeems that every thing which exceeds another of the ſame kind in ſuch a proportion, may be concluded to be of too big a Quantity; and ſo conſequently, we may affirm that there is no ſuch thing in the World. And hence it will follow, that Whales and Elephants are meer *Chimæra's*, and Poetical Fictions, becauſe they do ſo much exceed ſo many other Living Creatures. If all this eighth Sphere, (ſaith *Galilæus*) as great as it is, were a light Body, and placed ſo far from us that it appeared but as one of the leſſer Stars, we ſhould then eſteem it but little; and therefore we have no reaſon now to thruſt it out from being amongſt the Works of Nature, by reaſon of its too great Immenſity. 'Tis a frequent Speech of our Adverſaries, *Tycho*, *Fromondus*, and others, in excuſe of that incredible Swiftneſs which they imagine in their *primum mobile*, That 'twas requiſite the Motion of the Heavens ſhould have a kind of Infinity in it, the better to manifeſt the Infiniteneſs of the Creator. And why may not we as well affirm this concerning the Bigneſs of the Heavens? *Difficilius eſt accidens præ-*

ter

ter modulum ſubjecti intendere, quam ſubjectum ſine accidente augere (ſaith *Keplar.*) His Meaning is, that 'tis leſs abſurd to imagine the eighth Sphere of ſo vaſt a bigneſs, as long as it is without Motion, or at leaſt has but a very ſlow one; than to attribute unto it ſuch an incredible Celerity, as is altogether diſproportionable to its Bigneſs.

2. 'Tis the Acknowledgment of *Clavius*, and might eaſily be demonſtrated, That if the Center were faſtned upon the Pole of the World, the Orb wherein he ſuppoſes the Sun to move would not be able to reach ſo far in the eighth Sphere (being conſidered according to *Ptolomy*'s *Hypotheſis*) as to touch the Pole-Star; which notwithſtanding (ſaith he) is ſo near the Pole it ſelf, that we can ſcarce diſcern it to move: Nay, that Circle which the Pole-Star makes about the Pole, is above Four times bigger than the Orb of the Sun. So that according to the Opinion of our Adverſaries, though our Earth were at that diſtance from the Center, as they ſuppoſe the Sun to be, yet would not this *Eccentricity* make it nearer to any one part of the Firmament, than the Pole-Star is to the Pole; which according to his Confeſſion, is ſcarce ſenſible. And therefore according to their Opinion, it would cauſe very little difference in the appearance of thoſe Stars, the biggeſt of which does not ſeem to be of above five Seconds in its Diameter. *Comment. in Sphær. cap.* 1.

3. 'Tis conſiderable, That the Spheres of *Saturn*, *Jupiter*, *Mars*, are, according to the general Opinion, of very great Extenſion; and yet each of them is appointed only to carry about its particular Planet, which are but very little in compariſon of the fixed Stars. Now if for the Situation of theſe fixed Stars, there ſhould be allotted a proportionable part of the World, 'tis certain that their Orb muſt be far bigger than it is commonly ſuppoſed, and very near to this Opinion of *Copernicus*.

4. We uſually judge the bigneſs of the higher Orbs by their different Motions: As becauſe *Saturn* finiſhes his Courſe in Thirty Years, and *Jupiter* in Twelve, therefore we attribute unto thoſe Orbs ſuch a different proportion in their Bigneſs. Now if by this Rule we would find out the Quantity of the eighth Sphere, we ſhall diſcern it to be far nearer unto that Bigneſs which *Copernicus* ſuppoſeth it to have, than that which *Ptolomy*, *Tycho*, and others ordinarily aſcribe unto it: For the Starry Heaven (ſay they) does not finiſh his Courſe under 26000 Years; whereas *Saturn*, which is next unto it, does compaſs his Orb in Thirty Years. From whence it will probably follow, that there is a very great diſtance betwixt theſe in place, becauſe they have ſuch different Terms of their Revolutions.

But againſt this Anſwer unto the laſt Argument, our Adverſaries thus reply:

Fromond. Veſta. tract. 5. cap. 1. 1. If the fixed Stars are ſo far diſtant from us, that our approaching nearer unto them by 1000000 *German* Miles, does not make any ſenſible difference in their appearance; then *Galilæus*'s Perſpective could not make them ſeem of a bigger Form than they do to the bare Eye, which yet is contrary to common Experience.

Ibid. 2 From hence it may be inferred, That the leaſt fixed Star is bigger than all this Orb wherein we ſuppoſe the Earth to move; becauſe there is none of them but are of a ſenſible Bigneſs in reſpect of the Firmament, whereas this it ſeems is not.

Ibid. 3. Since God did at firſt create the Stars *for the uſe of all Nations that are under the whole Heavens*, Deut. 4. 19. it might have argued ſome Improvidence in him, if he had made them of ſuch vaſt Magnitudes; whereas they might as well beſtow their Light and Influences, and ſo conſequently be as ſerviceable to that end for which they were appointed, if they had been made with leſs Bodies, and placed nearer unto us. And 'tis a common *Maxim*, that Nature in all her Operations, does

does avoid Superfluities, and use the most compendious Way.

I answer:

1. To the First, whether the Perspective do make the fixed Stars appear bigger than they do to the bare Eye, cannot certainly be concluded, unless we had such an exact Glass, by which we might try the Experiment. But if in this kind we will trust the Authority of others, * *Keplar* tells us from the Experience of skilful Men, that the better the Perspective is, by so much the less will the fixed Stars appear through it, being but as meer Points, from which the Beams of Light do disperse themselves like Hairs. And 'tis commonly affirmed by others, that the Dog-star, which seems to be the biggest Star amongst those of the first Magnitude, does yet appear through this Glass but as a little Point no bigger than the fiftieth Part of *Jupiter*. Hence it is, that though the common Opinion hold the Stars of the first Magnitude to be two Minutes in their Diameter, and *Tycho* three; yet † *Galilæus*, who hath been most versed in the Experiments of his own Perspective concludes them to be but five Seconds.

* *Astron. Copern. lib. 4. par. 1.*

† *System. mundi, Coll. 3.*

2. To the Second: First we affirm, the fixed Stars to be of a vast Magnitude. But however, this Argument does not induce any Necessity that we should conceive them so big as the Earth's Orb. For it might easily be proved, that though a Star of the Sixth Magnitude were but equal in Diameter unto the Sun (which is far enough from the Greatness of the Earth's Orb;) yet the starry Heav'n would be at such a distance from us, that the Earth's Annual Motion could not cause any Difference in its Appearance.

Suppose the Diameter of the Sun to be about half a Degree, as our Adversaries grant; whereas a Star of the Sixth Magnitude is 50 Thirds, which is comprehended in that of the Sun 2160 Times. Now if the Sun were removed so far from us, that its Diameter would seem but as one of that number whereof it now con-

Vid. Gal. Ibid.

contains 2160; then muſt his Diſtance from us, be 2160 times greater than now it is: Which is all one, as if we ſhould ſay, that a Star of the Sixth Magnitude is ſevered from us by ſo many Semidiameters of the Earth's Orb. But now according to common Conſent, the Diſtance of the Earth from the Sun, does contain 128 Semidiameters of the Earth, and (as was ſaid before) this ſuppoſed Diſtance of the fixed Stars does comprehend 2160 Semidiameters of the Earth's Orb. From whence it is manifeſt, that the Semidiameter of the Earth, in compariſon to its Diſtance from the Sun, will be almoſt doubly bigger than the Semidiameter of the Earth's Orb, in compariſon to this Diſtance of the Stars. But now, the Semidiameter of the Earth, does make very little difference in the Appearance of the Sun, becauſe we ſee common Obſervations upon the Surface of it, are as exactly true to the Senſe, as if they were made from the Centre of it. Wherefore, that Difference which would be made in theſe fixed Stars, by the Annual Courſe of the Earth, muſt needs be much more unobſervable, or rather altogether inſenſible.

2. The Conſequence of this Argument is grounded upon this falſe Suppoſition, That every Body muſt neceſſarily be of an equal Extenſion to that Diſtance from whence there does not appear any ſenſible difference in its Quantity. So that when I ſee a Bird flying ſuch a height in the Air, that my being nearer unto it, or farther from it, by Ten or Twenty Foot, does not make it ſeem unto my Eyes either bigger or leſs; then I may conclude, that the Bird muſt needs be either Ten or Twenty Foot thick: Or when I ſee the Body of a Tree that may be half a Mile from me, and perceive that my approaching nearer to it by 30 or 40 Paces, does not ſenſibly make any different Appearance, I may then infer, that the Tree is Forty Paces thick; with many the like abſurd Conſequences,

that

that would follow from that Foundation upon which this Argument is bottomed.

To the Third I anſwer: 'Tis too much Preſumption, to conclude that to be Superfluous, the Uſefulneſs of which we do not underſtand. There be many ſecret ends in theſe great Works of Providence, which human Wiſdom cannot reach unto; and as *Solomon* ſpeaks of thoſe things that are under the Sun, ſo may we alſo of thoſe things that are above it; *That no man can find out the Works of God; for though a man labour to ſeek it out*, yea further, *Though a wiſe man think to know it, yet ſhall he not be able to find it.* Eccleſ. 8. 17. He that hath moſt inſight into the Works of Nature, is not able to give a ſatisfying Reaſon, why the Planets or Stars ſhould be placed juſt at this particular Diſtance from the Earth, and no nearer or farther. And beſides, this Argument might as well be urged againſt the *Hypotheſis* of *Ptolomy* or *Tycho*, ſince the Stars, for ought we know, might have been as ſerviceable to us, if they had been placed far nearer, than either of thoſe Authors ſuppoſe them. Again, were there any force in ſuch a Conſequence, it would as well conclude a great Improvidence of Nature, in making ſuch a Multitude of thoſe leſſer Stars, which have lately been diſcovered by the Perſpective. For to what purpoſe ſhould ſo many Lights be created for the Uſe of Man, ſince his Eyes were not able to diſcern them? So that our Diſability to comprehend all thoſe ends which might be aimed at in the Works of Nature, can be no ſufficient Argument to prove their Superfluity. Though Scripture do tell us that theſe things were made for our Uſe, yet it does not tell us, that this is their only end. 'Tis not impoſſible, but that there may be elſewhere ſome other Inhabitants, by whom theſe leſſer Stars may be more plainly diſcerned. And (as was ſaid before) why may not we affirm that of the Bigneſs, which our Adverſaries do concerning the Motion of the Hea-

Heavens? That God, to ſhew his own Immenſity, did put a kind of Infinity in the Creature.

There is yet another Argument to this purpoſe, urged by *Al. Roſſ.* which was not referred to any of the former kind, becauſe I could ſcarcely believe I did rightly underſtand it; ſince he puts it in the Front of his other Arguments, as being of Strength and Subtilty enough to be a Leader unto all the reſt; and yet in the moſt likely Senſe of it, 'tis ſo extremely ſimple to be preſſed in a Controverſy, that every Freſh-Man would laugh at it. The Words of it are theſe: *Quod minimum eſt in circulo debet eſſe centrum illius; at terra longe minor eſt Sole, & Æquinoctialis terreſtris eſt omnium in Cœlo circulus minimus; ergo,* &c.

Lib. 1. Sect. 2. c. 1.

By the ſame reaſon, it would rather follow, that the *Moon* or *Mercury* were in the Centre, ſince both theſe are leſs than the Earth. And then, whereas he ſays that the Æquinoctial of the Earth is the leaſt Circle in the Heavens, 'tis neither true nor pertinent, and would make one ſuſpect, that he who ſhould urge ſuch an Argument, did ſcarce underſtand any thing in Aſtronomy.

There are many other Objections like unto this, not worth the citing: The chief of all have been already anſwered; by which you may diſcern, that there is not any ſuch great Neceſſity as our Adverſaries pretend, why the Earth ſhould be ſituated in the midſt of the Univerſe.

PROP. VII.

'Tis probable that the Sun is in the Centre of the World.

THE chief Reaſons for the Confirmation of this Truth, are implyed in the Conveniences of this *Hypo-*

Hypotheſis above any other; whereby we may reſolve the Motions and Appearances of the Heavens into more eaſie and natural Cauſes.

Hence will the Frame of Nature be freed from that Deformity which it has according to the Syſtem of *Tycho*; who though he make the Sun to be in the midſt of the Planets, yet without any good Reaſon denies it to be in the midſt of the fixed Stars; as if the Planets, which are ſuch eminent parts of the World, ſhould be appointed to move about a diſtinct Centre of their own, which was beſide that of the Univerſe.

Hence likewiſe are we freed from many of thoſe Inconveniences in the *Hypotheſis* of *Ptolemy*, who ſuppoſed in the Heavens, *Epicycles* and *Eccentricks*, and other Orbs, which he calls the Deferents of the *Apoge* and *Perige*. As if Nature in framing this great Engine of the World, had been put unto ſuch hard ſhifts, that ſhe was fain to make uſe of Wheels and Screws, and other the like artificial Inſtruments of Motion.

There be ſundry other particulars, whereby this Opinion concerning the Sun's being in the Centre, may be ſtrongly evidenced; which becauſe they relate unto ſeveral Motions alſo, cannot therefore properly be inſiſted on in this Place. You may eaſily enough diſcern them, by conſidering the whole Frame of the Heavens, as they are according to the Syſtem of *Copernicus*; wherein all thoſe probable Reſolutions that are given for divers Appearances amongſt the Planets, do mainly depend upon this Suppoſition, that the Sun is in the Centre. Which Arguments (were there no other) might be abundantly enough for the Confirmation of it. But for the greater Plenty, there are likewiſe theſe Probabilities conſiderable.

1. It may ſeem agreeable to Reaſon, that the Light which is diffuſed in ſeveral Stars through the Circumference of the World, ſhould be more eminently contained, and (as it were) contracted in the Center of it, which can only be by placing the Sun there.

2. 'Tis an Argument of * *Clavius*, and frequently urged by our Adverſaries, That the moſt Natural ſituation of the Sun's Body was in the midſt, betwixt the other Planets; and that for this Reaſon, becauſe from thence he might more conveniently diſtribute amongſt them both his Light and Heat. The force of which may more properly be apply'd to prove him in the Center.

* *In prim. c. Spher.*

3. 'Tis probable that the Planetary Orbs (which are ſpecial parts of the *Univerſe*) do move about the Center of the World, rather than about any other Center which is remote from it. But now 'tis evident that the Planets *Saturn*, *Jupiter*, *Mars*, *Venus*, *Mercury*, do by their Motion encompaſs the Body of the Sun. 'Tis likely therefore that this is ſituated in the midſt of the World.

As for the three upper Planets, 'tis found by Obſervation, that they are always neareſt to the Earth when in oppoſition to the Sun, and fartheſt from us when in conjunction with it; which difference is ſo eminent, that *Mars* in his *Perige* does appear ſixty times bigger than when he is in the *Apoge*, and at the greateſt diſtance.

Now, that the Revolution of *Venus* and *Mercury* alſo is about the Sun, may from hence be evidenced: Firſt, becauſe they are never at any great diſtance from him. Secondly, becauſe they are ſeen ſometimes above, and ſometimes below him. Thirdly, becauſe *Venus*, according to her different ſituation, does change her Appearance as the Moon.

4. There

4. There is yet another Argument, which † *Aristotle* himself does repeat from *Pythagoræs*. The most excellent Body should have the best place; but the Sun is the most excellent Body, and the Center is the best place; therefore 'tis likely the Sun is in the Center. In the Frame of Nature (which is supposed to be of an Orbicular Form) there are but two places of any eminency, the Circumference and the Centre. The Circumference being of so wide a Capacity, cannot so fitly be the peculiar Seat of a Body, that is so little in respect of it: And besides, that which is the most Excellent part of the World, should be equally preserved in it self, and shared in its Virtues by all the other parts, which can only be done by its being placed in the midst of them. This is intimated unto us in that frequent Speech of *Plato*, that the Soul of the World does reside in the innermost place of it: And that in * *Macrobius*, who often compares the Sun in the World to the Heart in a Living Creature.

† *De Cælo. l.* 2. *c.* 13.

* *Saturnal. l.* 1. *c.* 17, &c.

Unto this *Aristotle* answers by a distinction: There is *medium magnitudinis*, so the Centre is the middle of a Sphere, And there is *medium naturæ*, or *informationis*, which is not always the same with the other; for in this Sense the Heart is the Middle of a Man; because from thence (saith he) as from the Centre, the Vital Spirits are conveyed to all the Members: And yet we know that it is not the Centre of Magnitude, or at an equal distance from all the other parts.

And besides, the Middle is the worst place, because most circumscribed, since that is more excellent which does limit any thing, than that which is bounded by it. For this Reason is it, that *Matter* is amongst those Things which are terminated, and *Form*, that which does circumscribe.

But against this Answer of *Aristotle*, it is again replyed:

1. Though

Keplar, Astr. Copern. l. 4. part. 2.

1. Though it be true, that in Living Creatures the best and chiefest part is not placed always just in the midst, yet this may be, because they are not of an Orbicular Form, as the World is.

2. Though that which bounds another Thing be more excellent than that which is terminated by it, yet this does not prove the Center to be the worst place, because that is one of the Terms or Limits of a Round Body, as well as the Circumference.

There are likewise other Arguments to this purpose, much insisted on by eminent Astronomers, taken from that Harmonical Proportion which there may be betwixt the several distance and bigness of the Orbs, if we suppose the Sun to be in the Centre.

Mæslin. præ. ad Narrat. Rhetici, Keplar, mysterium Cosmographicum.

For according to this (say they) we may conceive an Excellent Harmony both in the number and the distance of the Planets: (And if God made all other things *numero & mensurâ*, much more then those greater Works, the Heavens); for then the Five Mathematical Bodies, so much spoken of by * *Euclid*, will bear in them a proportion answerable to the several distances of the Planets from one another.

* *Lib.* 13. *prop.* 14, 15, &c.

Thus a *Cube* will measure the distance betwixt *Saturn* and *Jupiter*; a *Pyramis* or *Tetraëdron*, the distance betwixt *Jupiter* and *Mars*; a *Dodecaëdron*, the distance betwixt *Mars* and the Earth; an *Icosaëdron*, the distance betwixt the *Earth* and *Venus*; and an *Octaëdron*, the distance betwixt *Venus* and *Mercury*; that is, if we conceive a Circumference described immediately without the *Cube*, and another within it, the distance between these two will shew what proportional distance there is betwixt the Orb of *Saturn*, and that of *Jupiter*. Thus also if you conceive a Circumference described on the outside of a *Pyramis* or *Tetraëdron*, and another within it, this will shew such a proportional distance as there is betwixt the Orb of *Mars* from that of *Jupiter*. And so of the rest.

Now

Now if any ask why there are but six Planetary Orbs? *Keplar* answers: *Quia non oportet plures quàm quinque proportiones esse, totidem nempè quot regularia sunt in Matheſi corpora. Sex autèm termini consummant hunc proportionum numerum*. Because there are but five Proportions, so many as there are Regular Bodies in Mathematicks, each of whose Sides and Angles are equal to one another. But now there are six Terms required to consummate this number of Proportions; and so consequently, there can be but six primary Planets.

Thus likewise by placing the Sun in the Center, we may conceive such a proportion betwixt the Bodies of the Planets, as will be answerable unto their several Spheres: Then *Mercury*, which has the least Orb, will have the least Body; *Venus* bigger than that, but less than any of the other; our *Earth* bigger than *Venus*, but less than the rest; *Mars* bigger than the *Earth*, but less than *Jupiter*; *Jupiter* bigger than *Mars*, and less than *Saturn*, *Saturn* being the highest, should also be the biggest. All which Harmony would be disturbed by putting in the Sun amongst them; and therefore it may be more convenient for him to sit still in the Center.

There are sundry other Arguments in this kind to be found out, by a Consideration of this whole *Hypotheſis*: He that does rightly understand it, may therein easily discern many strong Probabilities, why the Sun should be in the midst of the World, rather than in any other Position.

PROP. VIII.

That there is not any ſufficient Reaſon to prove the Earth incapable of thoſe Motions which Copernicus *aſcribes unto it.*

THE two chief Motions in the World, which are more eſpecially remarkable above the reſt, are the *Diurnal*, and *Annual*.

The *Diurnal*, which makes the difference betwixt Night and Day, is cauſed by the Revolution of our Earth upon its own *Axis*, in the ſpace of four and twenty Hours.

The *Annual*, which makes the difference betwixt Winter and Summer, is likewiſe cauſed by the Earth, when being carried through the *Ecliptick* in its own Orb, it finiſhes its Courſe in a Year.

The firſt is uſually ſtiled, *Motus revolutionis*: The ſecond, *Motus circumlationis*: There is likewiſe a third, which *Copernicus* calls, *Motus inclinationis*: But this being throughly conſidered, cannot properly be ſtiled a Motion, but rather an Immutability, it being that whereby the *Axis* of the Earth does always keep parallel to it ſelf, from which ſituation it is not his annual Courſe that does make it in the leaſt manner to decline.

As for the Difficulties which concern the Second of theſe, they have been already handled in the Sixth Propoſition, where the Earth's *Eccentricity* was maintained.

So that the chief buſineſs of this Chapter, is to defend the Earth's Diurnal Motion, againſt the Objections of our Adverſaries. Sundry of which Objections, to ſpeak (as the truth is) do bear in them a great ſhew of probability, and ſuch too (as it ſeems) was very efficacious; ſince *Ariſtotle* and *Ptolomy*, *&c.* Men

of

of Excellent Parts and Deep Judgments, did ground upon them, as being of infallible and neceſſary conſequence.

I ſhall reckon them up ſeverally, and ſet down ſuch Anſwers unto each, as may yield ſome ſatisfaction to every indifferent ſeeker of Truth.

1. Firſt then, 'tis objected from our Senſes ; If the Earth did move, we ſhould perceive it. The Weſtern Mountains would then appear to aſcend towards the Stars, rather than the Stars to deſcend below them.

I anſwer : The Sight judges of Motion according as any thing does deſert the Plain whereon it ſelf is ſeated ; which Plain every where keeping the ſame ſituation and diſtance, in reſpect of the Eye, does therefore ſeem immovable unto it , and the Motion will appear in thoſe Stars and parts of the Heaven , through which the Vertical Line does paſs.

The Reaſon of ſuch Deceit may be this : Motion being not a proper Object of the Sight, nor belonging to any other peculiar Senſe , muſt therefore be judged of by the *Senſus communis*, which is liable to miſtake in this reſpect ; becauſe it apprehends the Eye it ſelf to reſt immovable, whilſt it does not feel any Effects of this Motion in the Body : As it is when a Man is carried in a Ship ; ſo that Senſe is but an ill Judge of Natural Secrets. 'Tis a good Rule of *Plato*, Εἰς τὸν νῦν ἀφορᾷν δεῖ φιλόσοφον καὶ μὴ εἰς τὼ ὄψιν : A Philoſopher muſt not be carried away by the bare Appearance of things to Sight, but muſt examine them by Reaſon. If this were a good Conſequence, The Earth does not move, becauſe it does not appear ſo to us, we might then as well argue , That it does move when we go upon the Water, according to the Verſe :

Provehimur portu, terræque, verbesque recedunt.

Or if such Arguments would hold, it were an easy matter to prove the Sun and Moon not so big as a Hat, or the fixed Stars as a Candle.

Al. Ross. l. 1. sect. 1. c. 1.

Yea, but if the Motion of the Heavens be only apparent, and not real, then the Motion of the Clouds will be so too, since the Eye may be as well deceived in the one as the other.

I answer: 'Tis all one, as if he should infer that the Sense was mistaken in every thing, because it was so in one thing: And this would be an excellent Argument to prove that Opinion of *Anaxagoras*, that the Snow was black.

The Reason why that Motion which is caused by the Earth does appear as if it were in the Heavens, is, because the *Sensus communis* in judging of it, does conceive the Eye to be it self immovable (as was said before) there being no Sense that does discern the Effects of any Motion in the Body; and therefore it does conclude every thing to move, which it does perceive to change its distance from it: So that the Clouds do not seem to move sometimes, when as notwithstanding they are every where carried about with our Earth, by such a swift Revolution; yet this can be no hindrance at all, why we may not judge aright of their other particular Motions, for which there is not the same Reason. Tho to a Man in a Ship, the Trees and Banks may seem to move, yet it would be but a weak Argument, to conclude from hence, that therefore such a one could not tell whether his Friend does really stir, whom he sees to walk up and down in the Ship: Or that he might as well be deceived in judging the Oars to move when they do not.

Ibid.

'Tis again reply'd by the same Objector, That it is not credible the Eye should be mistaken in judging of the Stars and Heavens; because those being light Bodies,

Bodies, are the primary and proper Objects of that Senſe.

I anſwer: The Deceit here is not concerning the Light or Colour of thoſe Bodies, but concerning their Motion; which is neither the primary nor proper Object of the Eye, but reckoned amongſt the *Objecta Communia.*

2. Another Common Argument againſt this Motion, is taken from the Danger that would thence ariſe, unto all high Buildings, which by this would quickly be ruinated, and ſcattered abroad.

I anſwer: This Motion is ſuppoſed to be natural; and thoſe Things which are according to Nature, have contrary effects to other Matters, which are by force and violence. Now it belongs unto Things of this latter kind to be inconſiſtent and hurtful; whereas thoſe of the firſt kind muſt be regular, and tending to conſervation. The Motion of the Earth is always equal and like it ſelf; not by ſtarts and fits. If a Glaſs of Beer may ſtand firmly enough in a Ship, when it moves ſwiftly upon a ſmooth Stream, much leſs then will the Motion of the Earth, which is more natural, and ſo conſequently more equal, cauſe any danger unto thoſe Buildings that are erected upon it. And therefore to ſuſpect any ſuch Event, would be like the Fear of *Lactantius*, who would not acknowledge the being of any *Antipodes*, leſt then he might be forced to grant that they ſhould fall down unto the Heavens. We have equal Reaſon to be afraid of high Buildings, if the whole World above us were whirled about with ſuch a mad Celerity as our Adverſaries ſuppoſe; for then there would be but ſmall hopes that this little point of Earth ſhould eſcape from the reſt.

Coper. l. 1. c. 8.

Gilbert de Magn. l. 6. c. 5.

But ſuppoſing (ſaith * *Roſſe*) that this Motion were natural to the Earth, yet it is not natural to Towns and Buildings, for theſe are artificial.

To which I anſwer: Ha, ha, he.

* *Lib. 1. ſect. 1. c. 3.*

3. Another Argument to this purpoſe is taken from the reſt and quietneſs of the Air about us; which could not be, if there were any ſuch ſwift Motion of the Earth. If a Man riding upon a fleet Horſe, do perceive the Air to beat againſt his Face, as if there were a Wind, what a vehement Tempeſt ſhould we continually feel from the *Eaſt*, if the Earth were turned about with ſuch a ſwift Revolution as is ſuppoſed.

Unto this 'tis uſually anſwered, That the Air alſo is carried along with the ſame Motion of the Earth: For if the Concavity of the Moon's Orb, which is of ſo ſmooth and glabrous a Superficies, may (according to our Adverſaries) drive along with it the greateſt part of this Elementary World, all the Regions of Fire, and all the vaſt upper Regions of Air, and (as ſome will have it) the two lower Regions, together with the Sea likewiſe; for from hence (ſaith *Alex. Roſſe, l.* 1. *ſect.* 1. *c.* 3.) is it, that betwixt the *Tropicks* there is a conſtant Eaſtern Wind, and a continual flowing of the Sea Weſtward: I ſay, if the Motion of the Heavens, which are ſmooth Bodies, may be able to carry with it ſo great a part of the Elementary World: Or if the rugged parts of the Moon's Body be able to carry with it ſo great a part of the Air, as *Fromondus* (*Ant. c.* 16.) affirms; much more then may our Earth, which is a rugged Mountainous Body, be able to turn about ſo little a part of the World, as that Vaporous Air next unto it.

Suppoſe the inward Circle to repreſent the Earth; and the outward the Thicker Air, which encompaſſes it. Now it is eaſily conceivable, that the Revolution of ſo great a Body as this Globe of Earth, may turn about by its meer Motion (if there were nothing elſe) ſo little a part of the adjoining Air, as is here repreſented: And yet,

1. The Diſproportion betwixt the Thickneſs of the Earth, and this Orb of Air, is far greater than could be expreſs'd in the Figure, being but as twenty Miles; which is at moſt the thickncſs of this Air, unto 3456 Miles, which is the Semidiameter of our Earth, and ſo is but as an inſenſible number in reſpect of this other.

2. Beſides the meer Motion of the Earth, which in probability (being ſuch a rugged Body) might be enough to carry ſo little a part of the Air along with it; there is alſo (as we ſuppoſe) a Magnetical Vigor which proceeds from it, whereby 'tis more able to make all Things that are near unto it, to obſerve the ſame Revolution.

*Li. 1. sect. 1. cap. 5.

But if it be so (saith * *Alex. Ross.*) that not only the Man, but the *Medium* also, and the Object be moved: This must needs be such a great hindrance to the sight, that the Eye cannot judge exactly of any thing. For, suppose the Man alone to be in a Motion, he could not see so well as when he is still; but now if not only he, but his Spectacles and Book were all moved, he would not be able to discern any thing distinctly.

I answer: The Consequence were pertinent, if all these were several Motions; but if the Subject and *Medium*, and Object, were all carried with one and the same equal Motion, (as it is here supposed) this could be no Impediment to the Act of Seeing, but it would be all one with the rest; because by this Means, they are not severed from one another, and therefore the *Species* are not disturbed. 'Tis an excellent Saying of *Galilæus*, and may serve for the Resolution of many such Doubts as these: *Motus eatenus tanquam motus operatur, quatenus relationem habet ad eas res quæ ipso distituuntur, in ijs vero rebus, quæ totæ æqualiter de eo participant, nihil operatur, & ita se habet ac si nullus esset.* If a Man be within some Room of a Ship, he may read altogether as easily when the Ship moves, as when it stands still.

*Syst. mundi, Colloq. 2.

4. Another Argument against this Circular Motion of the Earth, is grounded upon that common Principle amongst the *Aristotelians*: *Unius corporis simplicis unus tantum est motus.* One kind of Body has but one kind of Motion. But now the Earth and Water has a Motion of Descent; the Air a Motion of Ascent; and therefore none of them can have any Circular Motion natural unto them.

I answer: First, These right Motions of Elementary Bodies belong only to the Parts of them, and that too when they are out of their proper places; so that the whole to which they belong, may notwithstanding this, have another Motion of its own. But

Secondly,

Secondly, this Saying which *Ariſtotle* calls a Principle, will not conſiſt with other evident Experiments of Nature. Thus, though a Loadſtone, in reſpect of its Matter and Condenſity, naturally tends downward; yet this does not hinder, but that in reſpect of ſome other Qualities, as its deſire of Union and Coition to another Loadſtone, it may alſo naturally move upwards. From whence it will follow, that the ſame Elementary Body may have divers Natural Motions.

5. The Gravity and Magnitude of this Earthy Globe, do make it altogether unfit for ſo ſwift a Motion.

I anſwer: Firſt, Heavineſs can only be applied unto thoſe Bodies which are out of their proper Places, or unto ſuch parts as are ſevered from the whole to which they belong. And therefore the Globe of Earth, (conſidered as whole, and in its right place) cannot truly be called heavy. I deny not, but that there is in it, and ſo likewiſe in the other Planets, an Ineptitude to Motion, by reaſon of the Matter and Condenſity of their Bodies: And ſo likewiſe there is as truly (though not according to the ſame Degrees) in the leaſt particle of a Material condenſed Subſtance: So that this cannot reaſonably be pretended as a juſt Impediment, why the Earth ſhould be incapable of ſuch a Motion. Secondly, and though this Globe be of ſo vaſt a Magnitude, yet as Nature beſtows upon other Creatures (for Inſtance, an Eagle and a Fly) Spirits, and motive Powers, proportionable to their ſeveral Bodies; ſo likewiſe may ſhe endow the Earth with a Motive Faculty anſwerable to its Greatneſs. Or if this may make the Earth incapable of ſo ſwift a Motion as is ſuppoſed, much more then will the Heavens be diſabled for that greater Swiftneſs which is imagined in them. I might add, the Globe of the Sun and *Jupiter* are obſerved to move about their own Centers; and therefore the Earth, which is far leſs than either of them, is not, by reaſon of its too

great

great Magnitude, made unfit for ſuch a Revolution. Thirdly: As for the ſwiftneſs of the Earth's Courſe, it does not exceed (all Circumſtances well conſidered) the Celerity of ſome other Motions, with which we are acquainted; as that of the Clouds, when driven by a Tempeſtuous Wind; that of a Bullet ſhot from a Cannon, which in the ſpace of a Minute does fly 4 Miles: Or as another hath obſerved, in the ſecond Scruple of an Hour it may paſs the Fifteenth part of a *German* Mile. Than which, there is not any Point in the Earth's Equinoctial that moves faſter: And though a Bullet be much ſlower in moving a greater diſtance, yet for ſo little a ſpace, while the force of the Powder is moſt freſh and powerful, it does equal the ſwiftneſs of the Earth. And yet,

Mæſlin præfat. ad Narrat. Rhet. Fromond. Veſta. tract. 1. cap. 3.

1. A Bullet or Cloud is carried in its whole Body, being fain to break its way through the Air round about it: But now the Earth, (in reſpect of this firſt Motion) does remain ſtill in the ſame Situation, and move only about its own Center.

2. The Motion of a Bullet is violent, and againſt its Nature, which does ſtrongly incline it to move downwards: Whereas the Earth, being conſidered as whole, and in its proper place, is not heavy, nor does it contain any Repugnancy to a Circular Motion.

6. The chief Argument on which our Adverſaries do moſt inſiſt, is this. If there were ſuch a Motion of the Earth as is ſuppoſed, then thoſe Bodies which are ſevered from it in the Air, would be forſaken by it. The Clouds would ſeem to riſe and ſet as the Stars: The Birds would be carried away from their Neſts: No heavy Body could fall perpendicular: An Arrow or Bullet being ſhot from Eaſt to Weſt by the ſame violence, will not be carried an equal diſtance from us, but we ſhould by the Revolution of our Earth, overtake that which was ſhot to the Eaſt, before it could fall. If a Man leaping up, ſhould abide in the Air but one ſecond Scruple of an Hour, or the

Ariſt. de Cælo, lib. 2. cap. 13.

Sixtieth

Sixtieth part of a Minute, the Earth in that ſpace would withdraw it ſelf from him almoſt a quarter of a Mile. All theſe, and many other ſuch ſtrange Inferences, which are directly contrary to Senſe and Experience, would follow from this Motion of the Earth.

There are Three ſeveral Ways moſt frequently uſed for the Reſolving of theſe kind of Doubts.

1. From thoſe Magnetical Qualities, which all Elementary Bodies do partake of.

2. From the like Motion of other things, within the Room of a Sailing Ship.

3. From the like Participation of Motion in the open Parts of a Ship.

1. For thoſe *Magnetical* Properties, with which all theſe Bodies are endowed. For the better underſtanding of this, you muſt know, That beſides thoſe common Elementary Qualities of Heat, Coldneſs, Dryneſs, Moiſture, *&c.* which ariſe from the Predominancy of ſeveral Elements, there are likewiſe other Qualities (not ſo well known to the Ancients) which we call *Magnetical*, of which every Particle in the Terreſtrial Globe does neceſſarily participate: And whether it be joined to this Globe by Continuity or Contiguity, or whether it be ſevered from it, as the Clouds in the ſecond Region, a Bird, or Bullet in the Air; yet does it ſtill retain its Magnetical Qualities, together with all thoſe Operations that proceed from them.

Now from theſe Properties, do we ſuppoſe the Circular Motion of the Earth to ariſe.

If you ask what Probabilities there are, to prove that the Earth is endowed with any ſuch Affections; I anſwer: 'Tis likely, that the lower Parts of this Globe do not conſiſt of ſuch a ſoft fructifying Earth, as there is in the Surface, (becauſe there can be no ſuch uſe for it, as here, and Nature does nothing in vain,) but rather of ſome hard rocky Subſtance; ſince

ſince we may well conceive, that theſe lower Parts are preſſed cloſe together by the weight of all thoſe heavy Bodies above them. Now 'tis probable, that this rocky Subſtance is a Loadſtone, rather than a *Jaſpis*, *Adamant*, *Marble*, or any other; becauſe Experience teacheth us, that the Earth and Loadſtone do agree together in ſo many Properties. Suppoſe a Man were to judge the Matter of divers Bodies, each of which ſhould be wrapt up in ſome Covering from his Eye, ſo that he might only examine them by ſome other outward Signs: If in this Examination he ſhould find any particular Body which had all the Properties that are peculiar to a Loadſtone, he ſhould in reaſon conclude it to be of that Nature, rather than any other. Now there is altogether as much reaſon why we ſhould infer, that the inward Parts of the Earth do conſiſt of a Magnetical Subſtance. The Agreement of theſe two you may ſee largely ſet forth in the Treatiſe of D. *Gilbert*. I will inſtance only in one Example; which of it ſelf may ſufficiently evidence, that the Globe of Earth does partake of the like Affections with the Loadſtone. In the Mariners Needle you may obſerve the Magnetical Motions of *Direction*, *Variation*, *Declination*; the two laſt of which are found to be different, according to the Variety of Places. Now this Difference cannot proceed from the Needle it ſelf, becauſe that is the ſame every where. Nor can we well conceive how it ſhould be cauſed by the Heavens; for then the Variation would not be always alike in the ſame place, but diverſe, according to thoſe ſeveral Parts of the Heaven, which at ſeveral times ſhould happen to be over it: And therefore it muſt neceſſarily proceed from the Earth, which being it ſelf endowed with Magnetical Affections, does diverſly diſpoſe the Motions of the Needle, according to the difference of that Diſponent Virtue which is in its ſeveral Parts.

Now

Now to apply this unto the particular Inſtances of the Objection; We ſay, though ſome parts of this great Magnet, the Earth, may according to their Matter be ſevered from the whole; yet are they always joined to it by a Communion of the ſame Magnetical Qualities; and do no leſs obſerve theſe kind of Motions, when they are ſeparated from the whole, than if they were united to it. Nor need this ſeem incredible, that a heavy Bullet, in ſuch a ſwift violent Courſe, ſhould be able to obſerve this Magnetical Revolution of the whole Earth; when as we ſee that thoſe great Bodies of *Saturn*, *Jupiter*, &c. hanging in the vaſt Spaces of the Æthereal Air, do ſo conſtantly and regularly move on, in their appointed Courſes. Though we could not ſhew any Similitude of this Motion in theſe Inferior Bodies, with which we are acquainted; yet we muſt know, there may be many things which agree to the whole Frame, that are not diſcernible in the divers parts of it. 'Tis natural unto the Sea to ebb and flow; but yet there is not this Motion in every Drop or Bucket of Water. So if we conſider every part of our Bodies ſeverally, the Humours, Bones, Fleſh, *&c.* they are all of them apt to tend downwards, as being of a condenſed Matter; but yet conſider them according to the whole Frame, and then the Blood or Humours may naturally aſcend upwards to the Head, as well as deſcend to any of the lower Parts. Thus the whole Earth may move round, though the ſeveral parts of it have not any ſuch particular Revolution of their own. Thus likewiſe, tho' each condenſed Body being conſidered by it ſelf, may ſeem to have only a Motion of Deſcent; yet in reference to that whole Frame of which it is a part, it may alſo partake of another Motion that may be natural unto it.

But ſome may here object; Though the Earth were endowed with ſuch Magnetical Affections, yet what Probability is there that it ſhould have ſuch a Revolution?

tion? I anſwer; 'Tis obſerved of thoſe other Magnetical Bodies of *Saturn*, *Jupiter*, and the Sun, that they are carried about their own Centers; and therefore 'tis not improbable, but that it may be ſo with the Earth alſo; which if any deny, he muſt ſhew a Reaſon why in this reſpect they ſhould be unlike.

Yea, but though the Earth did move round, what ground is there to affirm that thoſe Bodies which are ſevered from it, as a Bullet, or the Clouds, ſhould follow it in the ſame Courſe?

I anſwer; Thoſe Spots which are diſcovered about the Sun, and are thought to be Clouds or Evaporations from his Body, are obſerved to be carried about according to his Revolution. Thus the Moon is turned round by our Earth; the Four leſſer Planets by the Body of *Jupiter*. Nay, thus all the Planets in their ſeveral Orbs, are moved about by the Revolution of the Sun, upon its own Axis, ſaith *Keplar*;) and therefore much more may an Arrow or Bullet be carried round by the Magnetical Motion of our Earth.

The Second Way, whereby ſome anſwer unto the Inſtances of this Argument, is, by ſhewing the like Motions of other things within ſome Room of a ſailing Ship. Thus Experience teaches (ſay they) that a Candle, as alſo the Fumes that come from it, will always keep the ſame Situation in the ſwifteſt Motion of a Ship, as if it did reſt immoveably, and the Flame will not more eſpecially bend one way, or have any troubled Fluctuation; but burn as ſtrait and quietly, as if it did ſtand ſtill. Again, it has been found (ſay thoſe that have been verſed in theſe kind of Experiments,) that the ſame force will caſt a Body but at an equal Diſtance, whether or no the Body do move with, or againſt the Motion of the Ship. As alſo that any Weight being let fall, will deſcend in as true a Perpendicular, as if the Ship did ſtand ſtill. If a Man leaping up, do tarry in the Air one ſecond Minute of an Hour; yet the Ship will not in its greateſt

Swift-

Swiftneſs (as it ſhould according to the Calculation of our Adverſaries) be carried from him at leaſt fifteen Foot. If we ſuppoſe a Man to jump in ſuch a Ship, he will not be able to paſs farther, when he jumps againſt the Motion of it, than when he jumps with it. All which Particulars may argue, that theſe things are carried along together, by the common Motion of the Ship. Now if Bodies may be thus jointly moved by ſuch a Preternatural Motion, much more then will they accompany the Earth in its diurnal Revolution, which we ſuppoſe to be Natural unto them, and as a Law impoſed by God in their firſt Creation.

If the Flame of a Candle, or the Smoak that comes from it, (things that are ſo eaſily moveable) are notwithſtanding carried ſo equally, and without any Diſturbance, by the Motion of a Ship; then alſo the Clouds in the Air, and all other light Bodies, may well enough be turned about by the Revolution of our Earth.

If an equal Force will caſt an heavy Body but at an equal Diſtance, whether or no it move with, or againſt the Motion of the Ship; then may we eaſily conceive, that an Arrow or Bullet being ſhot with the ſame Violence, will paſs but the ſame Space on the Earth, whether or no it be ſhot towards the *Eaſt* or *Weſt*.

If a heavy Body, while the Ship does move, will fall down in a ſtrait Line, then it is not the Revolution of our Earth that can hinder a Perpendicular Deſcent.

If a Man leaping up in a Ship, may abide in the Air one ſecond Scruple of an Hour, and yet this Ship in its greateſt Swiftneſs not withdraw it ſelf fifteen Foot; then will not the Earth in that Space go from him almoſt a quarter of a Mile.

But againſt this 'tis objected, That the Earth has the Similitude of an open Ship, and not of any Room that is cloſe. And though it be true, that when the Roof *Fromondus Veſt. Tract. 2. cap. 2.*

Roof and the Walls do all move together, the Air which is included betwixt them, muſt be carried along by the ſame Motion; yet it is not ſo with the Earth, becauſe that hath not any ſuch Walls or Roof, wherein it may contain and carry along with it the *Medium*. And therefore Experience will rather argue againſt this ſuppoſed Revolution. Thus 'tis obſerved, that a Stone being let fall from the Maſt of a Ship that moves ſwiftly, will not deſcend to the ſame Point, as if the Ship did ſtand ſtill. From whence it will follow, that if our Earth had ſuch a circular Motion, then any heavy Body being let fall from ſome high Tower, or other ſteep Place, would not deſcend unto that Point of Earth which was directly under it at the Beginning.

To this we anſwer; That the Air which moves along with our Earth, is as well limited in certain Bounds, as that which is included in a Room. If you ask where theſe Bounds are terminated; I anſwer, neither by the utmoſt parts of the World, nor yet by the Concavity of the Moon's Orb (as *Fromondus* would have us affirm;) but by the Sphere of vaporous Air that encompaſſes our Earth; or which is all one, by the Orb of Magnetical Vigor, which proceeds from it. And beſides, 'tis conſiderable that all Earthly Bodies are not only contained within theſe Limits, as things are in a cloſe Room, but alſo as parts in that whole to which they belong.

2. Though the carrying along of the *Medium* may ſolve the Motion of light Bodies in a Ship, as the Flame of a Candle, Smoak, or the like; yet this cannot concur to that which hath been ſaid of heavy Bodies, as a Man leaping up, a Bullet deſcending, *&c.* ſince it is not the Motion of the meer Air that is able to make theſe partake of the ſameMotion with the Ship. Unto that Argument which he urges from the Experiment of a Stone falling in an open Ship, we anſwer:

1. Though

1. Though the Inſtance of a Ship may ſerve as a Proof for this Opinion, it being an Argument *a minori ad majus*, from an accidental Motion to a natural; yet it will not ſerve againſt it. For though it were not thus in accidental Motions; yet this would not hinder but that it might be ſo in thoſe that are ſuppoſed to be proper and natural.

2. As for that Experiment it ſelf, 'tis but a groundleſs Imagination, and was never yet confirmed by any particular Experience; becauſe 'tis certain the Event would be clean otherwiſe, as ſhall be proved in the Third Way of Anſwering.

3. The Third and Laſt Way of clearing the Doubts in the ſixth Argument, is by ſhewing the like Participation of Motion, in thoſe things that are in the open Parts of a Ship. To which purpoſe *Galilæus* urges this Experiment: If any one ſhould let fall a Stone from an high Maſt, he would find *lapidem in eundem ſemper Navis locum decidere, ſeu conſiſtat illa, ſeu quantacunque velocitate moveatur*: That the Stone would always deſcend unto the very ſame Place, whether or no the Ship did move or ſtand ſtill. The reaſon of which is, becauſe the Motion of the Ship is likewiſe impreſſed in the Stone: Which Impreſſion is not equally prevalent in a light Body, as a Feather, or Wool, becauſe the Air which has power over them, is not carried along by the ſame Motion of the Ship. Thus likewiſe will it be in this other Experiment: If a Man upon a running Horſe ſhould in his ſwifteſt Courſe let fall a Bullet or Stone, theſe heavy Bodies, beſides their own Deſcent, would alſo participate that tranſverſe Motion of the Horſe. For as thoſe things that are thrown from us, do continue their Motion when they are out of the Hand in the open Air; ſo likewiſe muſt it be when the force is conferred by that Motion which the Arm has from the Horſe. While a Man is riding, his Arm is alſo carried by the ſame Swiftneſs

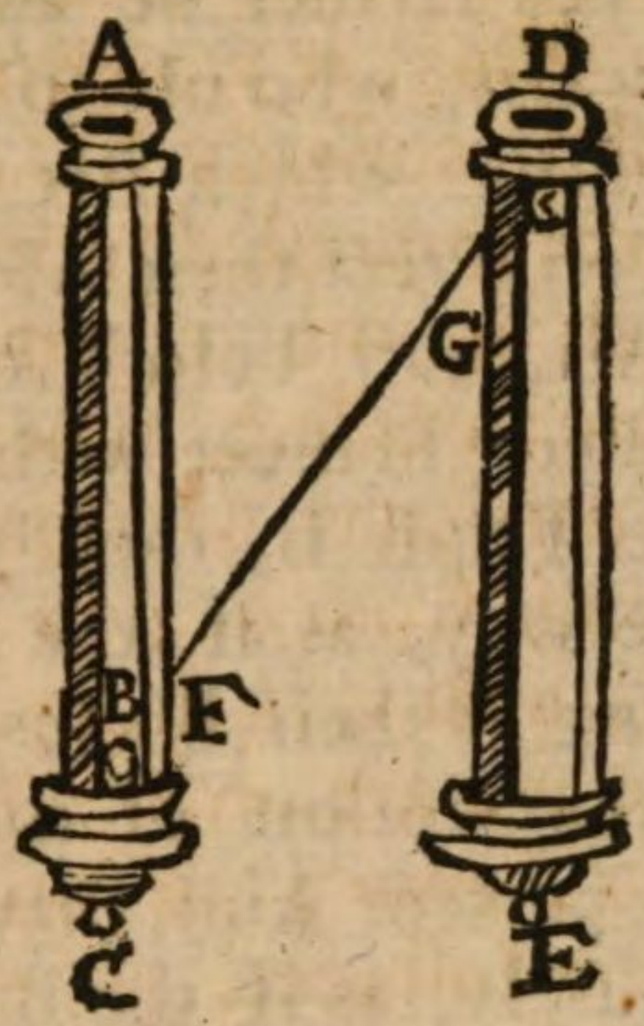
Syſt. Mund. Colloq. 2.

of the Horſe ; therefore, if he ſhould only open his Hand and let fall any thing, it would not deſcend in a ſtrait Line, but muſt neceſſarily be driven forward, by reaſon of that Force impreſſed in it by the Swiftneſs of the Horſe, which is alſo communicated to the Arm ; it being all one in Effect, whether or no the Arm be moved by a particular Motion of its own, as it is in caſting of things from us ; or by the common Motion of the Body, as it is in dropping of any thing from us, either when we are on the Top of ſome ſailing Ship, as in the *Former* ; or on ſome running Horſe, as in this *Latter* Inſtance.

What hath been ſaid concerning the Motion of Deſcent, is likewiſe appliable, both to that which is *upward*, and that which is *tranſverſal*. So that when 'tis objected, if the Earth did move, then a Bullet that were ſhot up perpindicularly would be forſaken by it, and not deſcend to the Place from whence it aroſe : We anſwer, that the Cannon which is upon the Earth, together with the Bullet in it, do partake of the ſame circular Motion with the Earth ; and this perhaps our Adverſaries will grant, whilſt we ſuppoſe the Bullet to remain ſtill in the Cannon; all the Difficulty will be to ſhew how it muſt neceſſarily obſerve the ſame Motion, when it is ſhot out into the open Air. For the better Explication of this, you may note this following Figure.

Gall. Syſt. Colloq. 2.

Where



Where we ſuppoſe *A C* to be a Cannon perpendicularly, erected with a Bullet in it at *B*, which if it were immoveable, we grant that the Bullet being diſcharged, muſt aſcend in a juſt Perpindicular. But now conceive this Cannon to move along with the Earth, then in that Space of Time while the Bullet by the Force of the Powder is aſcending to the Top of the Bore, the Cannon will be transferred to the Situation *D E*; ſo that the Bullet muſt be moved according to the Line *F G*, which is not directly upright, but ſomewhat declining. Now the Motion of the Bullet in the Air, muſt neceſſarily be conformed unto that Direction that is impreſſed in it by the Cannon from whence it is ſhot, and ſo conſequently it muſt be continued according to the Line *F G*, and therefore will always keep perpendicularly over the Point from which it did aſcend.

If you reply, that the Motion of the Bullet in the Cannon muſt needs be ſo ſwift, that the Earth cannot carry the Cannon from *C* to *E*, in the ſame Space of Time wherein the Bullet does move from *B* to *A*. I anſwer; 'tis not material whether the Earth be of a greater or leſſer Swiftneſs than the Bullet, becauſe the Declination muſt always be proportionable to the Motion of the Earth; and if we ſuppoſe this to be ſlower than the Bullet, then the Declination of the Line *F G*, will be ſo much the leſs.

This Truth may yet farther be illuſtrated by the Practice of thoſe Fowlers, who uſe to kill Birds as they are flying: Concerning which Art, 'tis commonly thought that theſe Men direct their Aims to ſome certain Space in the Air, juſt before the Birds, where they conceive the Bullet will meet with them in their Flight; whereas the Truth is, they proceed in this caſe, the very ſame way, as if the Birds did ſtand ſtill, by a direct aiming at their Bodies, and following of their Flight by the Motion of the Piece, till at length, having got a perfect Aim, they diſcharge, and do hit altogether as ſurely, as if the Birds were ſitting upon a Tree. From whence we may obſerve, that the Motion of the Piece, as in our aiming it is made to follow the Birds in their Flight (though it be but ſlow,) yet is communicated to the Bullet in the Air.

But here it may ſeem very difficult to give any reaſon according to thoſe Grounds concerning the Flight of Birds; which being animated, have a Liberty to fly here or there, to tarry for a good Space of Time in the open Air, and ſo 'tis not eaſie to conceive what means there is, by which they ſhould participate of the Earth's diurnal Revolution.

To this *Galilæus* anſwers, that the motion of the Air, as it does turn about the Clouds, ſo doth it alſo carry with it the Birds, together with ſuch other like things that are in it. For if ſome violent Wind be able to drive with ſuch Swiftneſs a full laden Ship, to throw down Towers, to turn up Trees, and the like; much more then may the diurnal Motion of the Air, (which does ſo far exceed in Swiftneſs the moſt tempeſtuous Wind) be able to carry with it the Bodies of Birds.

Ob. But if all things be turned about by this Revolution, then it ſhould ſeem there is no ſuch thing as a right motion, whether of Aſcent, or Deſcent in a ſtrait Line.

I anſwer;

I anſwer; The moving of heavy or light Bodies, may be conſidered in a double Relation. *So.*

1. According to the Space wherein they move, and we grant their Motions not to be ſimple, but mixed of a direct and circular.

2. According to the Body or *Medium* wherein they move, and then they may properly be ſaid to have right Motions, becauſe they paſs through the *Medium* in a ſtrait Line; and therefore it is, that unto us they ſeem directly to aſcend or deſcend. *Ariſtotle* himſelf would not deny, but that Fire may aſcend in a ſtrait Line unto its Sphere; and yet participate alſo of that circular Motion which he ſuppoſes to be communicated from the Heaven, unto the upper part of the Air, and its own Region. So likewiſe muſt it be for the Deſcent of any thing. Suppoſe a Ship in its ſwifteſt Motion, and a Man in it, having ſome Veſſel filled with Water, ſhould let fall into it a little Ball of Wax, or ſome other matter which may be ſlow in its ſinking, ſo that in one Minute it ſhould ſcarce deſcend the Space of a Cubit, though the Ship (it may be) in the ſame time may paſs at leaſt a hundred Cubits; yet would this ſtill ſeem unto the Eye to deſcend in a ſtrait Line; and the other Motion which is communicated unto it by the Ship, would not at all be diſcernible in it. And though in this Caſe, the Motion were in it ſelf compoſed of a circular and direct; yet in reſpect of us it would appear, and ſo might be ſtiled, exactly ſtrait.

Now if it be thus in thoſe which are generally granted to be preternatural Motions; we need not doubt then the poſſibility of the like effect in that Motion which we conceive to be proper and natural, both to the Earth, and the things that belong unto it.

There is yet another Objection to this purpoſe urged by * *Malapertius*, a late Jeſuit; who, though he do with much eagerneſs preſs this Argument concern- * *Auſtriaca Syder. par 2. prop. 2*

ing a Bullet or Stone, againſt the Opinion of *Copernicus*; yet he grants that it might eaſily be reſolved, if the Defenders of it would affirm that the Air did move round with the Earth. But this, ſays he, they dare not avouch; for then the Comets would always ſeem to ſtand ſtill, being carried about with the Revolution of this Air; and then they could not riſe or ſet, as Experience ſhews they do.

To this it may be anſwered, That moſt Comets are above that Sphere of Air which is turned round with our Earth, as is manifeſt by their height. The Motion that appears in them, is cauſed by the Revolution of our Earth, whereby we are turned from them.

As for thoſe which are within the Orb of our Air, theſe do ſeem to ſtand ſtill. Such a one was that mentioned by † *Joſephus*, which did conſtantly hang over *Jeruſalem*; and that likewiſe which appeared aboat the time of *Agrippa*'s Death, and for many Days together did hang over the City of *Rome*. Wherefore ∴ *Seneca* does well diſtinguiſh out of *Epigenes*, betwixt two ſorts of Comets; the one being low, and ſuch as ſeem immovable; the other higher, and ſuch as did conſtantly obſerve their Riſings and Settings, as the Stars.

† *De bello Judaico, l. 7. cap. 12. Dion. l. 54.*

∴ *Nat. Qu. lib. 7. cap. 6.*

I have done with all the Arguments of any Note or Difficulty, that are urged againſt this Diurnal Motion of the Earth. Many other Cavils there are, not worth the naming, which diſcover themſelves to be rather the Objections of a captious, than a doubtful Mind. Amongſt which, I might juſtly paſs over thoſe that are ſet down by *Alex. Roſſe*. But becauſe this Author does proceed in his whole Diſcourſe with ſo much Scorn and Triumph, it will not be amiſs therefore to examine what infallible Evidence there is in thoſe Arguments upon which he grounds his Boaſtings.

Lib. 1. ſect. 2. cap. 6.

We have in one Chapter no leſs than theſe Nine.

1. If

1. If the Earth did move, then would it be hotter than the Water, because Motion does produce Heat: And for this Reason likewise, the Water would be so hot and rarified, that it could not be congealed; since that also does partake of the same Motion with the Earth. *Arg.* 1.

2. The Air which is next the Earth, would be purer, as being rarified with Motion. *Arg.* 2.

3. If the Earth did move the Air, it would cause some Sound; but this is no more audible, than *Pythagoras*'s Harmony of the Heavens. *Arg.* 3.

4. 'Twould have been in vain for Nature to have endowed the Heavens with all Conditions requisite for Motion, if they had been to stand still. As first, they have a round Figure. Secondly, they have neither Gravity nor Levity. Thirdly, they are Incorruptible. Fourthly, they have no Contrary. *Arg.* 4.

5. All Similary Parts are of the same Nature with the whole: But each part of the Earth does rest in its place; therefore also doth the whole. *Arg.* 5.

6. The Sun in the World is as the Heart in a Man's Body; but the Motion of the Heart ceasing, none of the Members do stir: Therefore also if the Sun should stand still, the other Parts of the World would be without Motion. *Arg.* 6.

7. The Sun and Heavens do work upon these Inferior Bodies by their Light and Motion. So the Moon does operate upon the Sea. *Arg.* 7.

8. The Earth is the Foundation of Buildings, and therefore must be firm and stable. *Arg.* 8.

9. 'Tis the constant Opinion of Divines, That the Heavens shall rest after the Day of Judgment; which they prove from *Isa.* 6. 20. *Thy Sun shall no more go down, neither shall thy Moon withdraw it self.* So likewise, *Rev.* 10. 6. The Angel swears *that there shall be time no longer*; and therefore the Heavens must rest, since by their Motion it is that Time is measured. And St. *Paul* says, *Rom.* 8. 20. *That all the Creatures* *Arg.* 9.

are subject to Vanity. Now this can be no other in the Heavens, than the Vanity of Motion, which the Wise Man speaks of, *Eccles.* 1. 4. *The Sun riseth, and the Sun goeth down,* &c.

To these it may be Answered:

Ad. 1. & 2. In the first you may note a manifest Contradiction, when he will have the Earth to be hotter than the Water, by reason of this Motion; when as notwithstanding, he acknowledges the Water to move along with it! And therefore too in the next Line, he infers that the Water, because of that Heat and Rarefaction which it receives from this Motion with the Earth, must be incapable of so much Cold, as to be congealed into Ice.

But unto that which may be conceived to be his Meaning in this and the next Argument; I answer: If he had fully understood this Opinion which he opposes, he would easily have apprehended that it could not be prejudiced by either of these Consequences. For we suppose that not only this Globe of Earth and Water, but also all the vaporous Air which environs it, are carried along by the same Motion. And therefore, though what he says concerning the Heat; which would be produced by such a Motion, were true, yet it would not be pertinent, since our Earth and Water, and the Air next unto them, are not by this means severed from one another, and so do not come within the compass of this Argument.

If any reply, That this will notwithstanding hold true concerning the upper part of the Air, where there is such a Separation of one Body from another; and so consequently, an answerable Heat. I answer,

1. 'Tis not generally granted, That Motion in all kind of Bodies does produce Heat; some restrain it only to solid Bodies, affirming, That in those which are fluid, it is rather the cause of Coldness. This is the reason, say they, why running Waters are ever to our sense the coolest; and why, amongst those Winds

which

which proceed from the ſame Coaſts of Heaven, about the ſame time of the Year, the ſtrongeſt always is the coldeſt? If you object, that running Waters are not ſo ſoon frozen as others, they anſwer; This is not becauſe they are thereby heated, but becauſe unto Congelation it is requiſite that a Body ſhould ſettle and reſt, as well as be cold.

2. If we ſhould grant a moderate heat in thoſe parts of the Air, we have not any Experiment to the contrary, nor would it prejudice the preſent Opinion, or common Principles.

As the ſound of this Motion is not more heard than the Harmony of the Heavens; ſo neither is there any Reaſon why this Motion ſhould cauſe a ſound, more than the ſuppoſed Motion of the Heavens, which is likewiſe thought to be continued unto the Air hard by us. *Ad.* 3.

This will prove the Earth to move as well as the Heavens: For that has, firſt, a round Figure, as is generally granted. Secondly, being conſidered as whole, and in its proper place, it is not heavy, as was proved before. And as for the two other Conditions, neither are they true of the Heavens, nor if they were, would they at all conduce to their Motion. *Ad.* 4.

1. This Argument would prove that the Sea did not Ebb and Flow, becauſe there is not the ſame kind of Motion in every Drop of Water; or that the whole Earth is not Spherical, becauſe every little piece of it is not of the ſame Form. *Ad.* 5.

This is rather an Illuſtration than a Proof; or if it do prove any thing, it may ſerve as well for that purpoſe unto which it is afterward applied, where the Motion of every Planet is ſuppoſed to depend upon the Revolution of the Sun. *Ad.* 6.

That the Sun and Planets do work upon the Earth by their own real daily Motion, is the thing in Queſtion; and therefore muſt not be taken for a common Ground. *Ad.* 7.

We

Ad. 8. We grant that the Earth is firm and ſtable from all ſuch Motions whereby it is joggled or uncertainly ſhaken.

Ad. 9. 1. For the Authority of thoſe Divines, which he urges for the Interpretation of theſe Scriptures; this will be but a weak Argument againſt that Opinion which is already granted to be a Paradox.

2. The Scriptures themſelves, in their right meaning, will not at all conduce to the preſent purpoſe.

As for that in *Iſaiah*, if we conſult the Coherence, we ſhall find that the Scope of the Prophet is to ſet forth the Glory of the Church Triumphant. Wherein he ſays there ſhall not be any need of the Sun or Moon, but God's Preſence ſhall ſupply them both: *For the Lord ſhall be unto thee an everlaſting Light, and thy God thy Glory, ver.* 19. and as for this Sun and Moon, it ſhall not go down, or withdraw it ſelf, but he ſhall be an *everlaſting Light* without Intermiſſion. So that 'tis evident he ſpeaks of that Light which ſhall hereafter be inſtead of the Sun and Moon.

Vid. Revel. 21.23. *item* c.22. *ver.* 5.

As for that in the *Revelations*, we yield that *time ſhall ceaſe*; but to ſay that this depends upon the Ceſſation of the Heavens, is to beg the Queſtion, and to ſuppoſe that which is to be proved; *viz.* That Time is meaſured by the motion of the Heavens, and not of the Earth. *Perrerius* (from whom this laſt Argument was borrowed without Acknowledgment) might have told him in the very ſame place, that Time does not abſolutely and univerſally depend upon the Motion of the Heavens, *ſed in motu & ſucceſſione, cujuſlibet durationis*, but in any ſuch Succeſſion, by which Duration may be meaſured.

Gen. c. 1. *l.* 2. *quæſt.* 6.

As for that in the *Romans*, we ſay, That there are other Vanities to which the Heavenly Bodies are ſubject: As firſt, unto many Changes and Alterations; witneſs thoſe Comets which at ſeveral times have been diſcerned amongſt them; and then likewiſe to

that

that general Corruption, in which all the Creatures shall be involved at the last Day. *When they shall pass away with a great noise, and the Elements shall melt with fervent Heat.* 2 *Pet.* 3. 10, 12.

Thus you see, there is not any such invincible strength in these Arguments, as might cause the Author of them to triumph before-hand with any great Noise of Victory.

Another Objection like unto these is taken from the Etymology of several Words. Thus the Heavens are called *Æthera, ab ἀεὶ θεῖν,* because they are always in motion, and the Earth *Vesta, qui vi stat,* because of its Immobility.

To which I answer: 'Twere no difficult matter to find such Proofs for this Opinion, as well as against it.

Thus we may say that the *Hebrew* Word ארץ is derived from רוץ *quia currit*; and *Terra, non quod terratur, sed quod perenni cursu omnia terat,* saith *Calcagnius*. However, though we suppose the Etymology to be never so true and genuine, yet it can at the best but shew what the more common Opinion was of those Times when such Names were first imposed.

But suppose all this were so, That the Earth had such a diurnal Revolution; yet how is it conceivable that it should at the same time have two distinct Motions? *Ob.*

I answer: This may easily be apprehended, if you consider how both these Motions do tend the same way from West to East. Thus a Bowl being turned out of the Hand, has two Motions in the Air; one, whereby it is carried round; the other, whereby it is cast forward. *Sol.*

From what hath been delivered in this Chapter, the indifferent Reader may gather some Satisfaction for those Arguments which are usually urged against this Diurnal Motion of the Earth.

PROP.

PROP. IX.

That it is more probable the Earth does move, than the Sun or Heavens.

AMongſt thoſe many Arguments that may be urged for the Confirmation of this Truth, I ſhall ſet down only theſe Five.

1. If we ſuppoſe the Earth to be the cauſe of this Motion, then will thoſe vaſt and glorious Bodies of the Heavens be freed from that inconceivable, unnatural ſwiftneſs, which muſt otherwiſe be attributed unto them.

Vid. Meſt. Epit. Aſtr. l. 1. in fine.

For if the Diurnal Revolution be in the Heavens, then it will follow according to the common *Hypotheſis*, that each Star in the *Equator* muſt in every Hour move at the leaſt 4529538 *German* Miles. So that according to the Obſervation of *Cardan*, who tells us that the Pulſe of a well-tempered Man does beat 4000 times in an Hour; one of theſe Stars in that ſpace, whilſt the Pulſe beats once, muſt paſs 1132 *German* Miles (ſaith *Alphraganus*:) Or according to *Tycho*, 732 *German* Miles. But theſe Numbers ſeem to be ſomewhat of the leaſt, and therefore many others do much enlarge them, affirming that every Star in the *Equator*, in one beating of the Pulſe, muſt move 2528 of theſe Miles.

De Prop. l. 5. prop. 58.

Comment. in prim. cap. Sphæra.

'Tis the Aſſertion of *Clavius*, That though the diſtance of the Orbs, and ſo conſequently their ſwiftneſs, ſeem to be altogether incredible; yet it is rather far greater in it ſelf than Aſtronomers uſually ſuppoſe it; and yet, ſaith he, according to the common Grounds, every Star in the *Equator* muſt move 42398437½ Miles in an Hour. And though a Man ſhould conſtantly travel 40 Miles a Day, yet he would not be able to go ſo far as a Star does in one Hour,

under

under 2904 Years : Or if we will ſuppoſe an Arrow to be of the ſame ſwiftneſs, then muſt it compaſs this great Globe of Earth and Water 1884 times in an Hour. And a Bird that could but fly as faſt, might go round the World ſeven times in that ſpace, whilſt one could ſay, *Ave Maria, gratia plena, Dominus tecum.*

Which though it be a pretty round pace, yet you muſt conceive that all this is ſpoken only of the eighth Sphere ; and ſo being compared to the ſwiftneſs of the *Primum Mobile*, is but a ſlow and heavy Motion.

For (ſaith the ſame Author) the thickneſs of each Orb is equal to the diſtance of its Concave Superficies from the Center of the Earth. Thus the Orb of the Moon does contain as much ſpace in its thickneſs, as there is betwixt the neareſt parts of that and the Center. Thus alſo the eighth Sphere is as thick as that whole ſpace betwixt the Center of the Earth and its own Concave Superficies. So likewiſe muſt it be in thoſe Three other Orbs, which he ſuppoſes to be above the Starry Heaven. Now if we proportion their ſwiftneſs according to this difference in their bigneſs, you may then conceive (if you can) what a kind of Celerity that muſt be, by which the *Primum Mobile* will be whirled about.

Tycho makes the diſtance of the Stars to be much leſs, and their Motion ſlower ; and yet he is fain to confeſs, that it is *omni cogitatione celerior.*

Clavius likewiſe ſpeaking concerning the Swiftneſs of the Starry Orb, does acknowledge, *Quod velocitas ejus captum humani ingenij excedit.* What then could he think of the *Primum Mobile* ?

Dr. *Gilbert* being it ſeems aſtoniſhed at the conſideration of this ſtrange Swiftneſs, ſays of it, that it is *motus ſupra omnes cogitationes, ſomnia, fabulas & licentias poeticas inſuperabilis, ineffabilis, incomprehenſibilis.* A Man may more eaſily conceive the poſſibility of any Fable or Fiction, how Beaſts and Trees might talk together, *De magnete, l.6. c.3.*

gether, than how any Material Body ſhould be moved with ſuch a Swiftneſs.

Not but that 'tis poſſible for God to turn them about with a far greater Velocity. Nay 'tis poſſible for Art to contrive a Motion, which ſhall be equally ſlow in that proportion as this is ſwift. But however, the Queſtion here is not what can be done, but what is moſt likely to be done according to the uſual Courſe of Nature. 'Tis the part of a Philoſopher, in the Reſolution of Natural Events, not to fly unto the Abſolute Power of God, and tell us what he can do, but what according to the uſual way of Providence, is moſt likely to be done, to find out ſuch Cauſes of Things, as may ſeem moſt eaſy and probable to our Reaſon.

If you ask what repugnancy there is in the Heavens, unto ſo great a ſwiftneſs: We anſwer, Their being ſuch vaſt material condenſed Subſtances, with which this inconceivable Motion cannot agree.

Since Motion and Magnitude are two ſuch Geometrical Things, as bear a mutual proportion to one another; therefore it may ſeem convenient, that ſlowneſs ſhould be more agreeable to a great Body, and ſwiftneſs to a leſſer: And ſo it ſhould be more conſonant to the Principles of Nature, that the Earth, which is of a leſſer quantity, ſhould be appointed to ſuch a motion as is ſomewhat proportionable to its bigneſs, than that the Heavens that are of ſuch a vaſt magnitude, ſhould be whirled about with ſuch an incredible ſwiftneſs, which does as far exceed the proportion of their bigneſs, as their bigneſs does exceed this Earth, that is but a Point or Centre to them. 'Tis not likely that Nature in theſe conſtant and great Works, ſhould ſo much deviate from that uſual Harmony and Proportion which ſhe obſerves in leſſer Matters. If this Globe of Earth only were appointed to move every Day round the Orb of the fixed Stars, though it be but a little Body, and ſo more capable of a ſwift motion;

tion ; yet that ſwiftneſs would be ſo extreamly diſproportionable unto it, that we could not with Reaſon conceive it poſſible, according to the uſual courſe of Nature. But now that the Heavens themſelves, of ſuch ſtrange bigneſs, with ſo many Stars, which do ſo far exceed the magnitude of our Earth, ſhould be able to turn about with the ſame celerity : Oh ! 'tis altogether beyond the Fancy of a Poet or a Madman.

For Anſwer unto this Argument, our Adverſaries tell us, That there is not in the Heavens any repugnancy to ſo ſwift a motion ; and that whether we conſider the nature of thoſe Bodies; or, ſecondly, the ſwiftneſs of this motion.

1. For the Nature of thoſe Bodies, either their { *Qualities.* / *Quantity.*

1. There is not in them the Qualities of Lightneſs or Heavineſs, or any the leaſt Contrariety that may make them reluctant to one another.

2. Their Magnitude will help them in their ſwiftneſs : For the greater any Body is, the quicker will it be in its motion, and that not only when it is moved by an inward Principle, as a Millſtone will deſcend faſter than a little Pibble ; but alſo when its motion does proceed from ſome External Agent ; as the Wind will drive a great Cloud, or a heavy Ship, when it is not able to ſtir a little Stone. *Raſſ. l. 1. ſect. 1. c. 1.*

2. As for the ſwiftneſs of this Motion, the poſſibility of it may be illuſtrated by other Particulars in Nature : As,

1. The Sound of a Cannon, in a little time is carried for twenty Miles diſtance. *Idem. l. 2. ſect. 1. c. 5.*

2. Though a Star be ſituated ſo remotely from us, yet the Eye diſcerns it in a moment, which is not without ſome motion, either of the Species of the Star, or the Rays of the Eye. Thus alſo the Light does in an inſtant paſs from one ſide of the Heaven to another. *Idem, l. 1. ſect. 1. c. 2.*

3. If

3. If the force of Powder be able to carry a Bullet with so great a swiftness, we need not doubt then, but that the Heavens are capable of such a celerity as is usually attributed unto them.

Unto these it may be answered:

1. Where they say that the Heavenly Bodies are without all gravity, we grant it, in the same sense as our Earth also, being considered as whole, and in its proper place, may be deny'd to be heavy: Since this Quality in the exactest Sense, can only be ascribed unto such parts as are severed from the whole to which they belong. But however, since the Heavensor Stars are of a material Substance, 'tis impossible but there should be in them some ineptitude to motion; because Matter is of it self a dull and sluggish thing; and by so much the more, as it is kept close and condensed together. And though the Followers of *Ptolomy* do with much confidence deny the Heavens to be capable of any reluctancy to Motion, yet it were easy to prove the contrary out of their own Principles. 'Tis not conceivable how the upper Sphere should move the nether, unless their Superficies were full of rugged parts (which they deny): Or else one of the Orbs must lean upon the other with its weight, and so make it partake of its own Motion. And besides, they tell us, that the farther any Sphere is distant from the *primum mobile*, the less is it hindred by that in its proper Course, and the sooner does it finish its own Revolution. From whence it will easily follow, that these Bodies have resistency from one another.

I have often wondred why amongst the Enchanted Buildings of the Poets, they have not feigned any Castle to be made of the same Materials with the Solid Orbs, since in such a Fabrick there would have been these Eminent Conveniences.

1. It must needs be very pleasant, by reason of its perspicuity, because it is more diaphanous than the Air it self, and so the Walls of it could not hinder the Prospect any way.

2. Be-

2. Being ſo ſolid and impenetrable, it muſt needs be excellent againſt all violence of Weathers, as alſo againſt the Aſſaults of the Enemy, who ſhould not be able to break it with the moſt furious Batteries of the Ram, or pierce it with any Cannon Shot.

3. Being void of all Heavineſs, a Man may carry it up and down with him, as a Snail does his Houſe; and ſo whether he follow the Enemy, or fly from him, he has ſtill this Advantage, that he may take his Caſtle and Defence along with him.

But then again, there are on the other ſide as many Inconveniences. For,

1. Its Perſpecuity would make it ſo open, that a man ſhould not be able to retire himſelf into any private part of it. And then,

2. Being ſo extremely ſolid, as well as inviſible, a man ſhould be ſtill in danger of knocking his Head againſt every Wall and Pillar; unleſs it were alſo intangible, as ſome of the *Peripateticks* affirm.

3. Its being without all Gravity, would bring this Inconvenience, that every little Puff of Wind would blow it up and down; ſince ſome of the ſame Sect are not aſhamed to ſay, that the Heavens are ſo utterly devoid of Heavineſs, that if but a little Fly ſhould juſtle againſt the vaſt Frame of the Cœleſtial Spheres, he would move them out of their Places.

A ſtrong Fancy, that could be at leiſure, might make excellent Sport with this Aſtronomical Fiction.

So that this firſt Evaſion of our Adverſaries will not ſhelter them from the force of that Argument, which is taken from the incredible ſwiftneſs of the Heavens.

2. Whereas they tell us in the ſecond place, that a bigger Body, as a Millſtone, will naturally deſcend ſwifter than a leſs, as a Pibble. I anſwer: This is not becauſe ſuch a great Body is in it ſelf more eaſily

movable, but becauſe the bigger any thing is which is out of its own Place, the ſtronger will be its natural deſire of returning thither, and ſo conſequently, the quicker its Motion. But now thoſe Bodies that move circularly, are always in their proper Situations, and ſo the ſame Reaſon is not appliable unto them. And then, whereas 'tis ſaid, that Magnitude does always add to the ſwiftneſs of a violent Motion (as Wind will move a great Ship ſooner than a little Stone:) We anſwer: This is not becauſe a Ship is more eaſily movable in it ſelf than a little Stone: For I ſuppoſe the Objector will not think he can throw the one as far as the other; but becauſe theſe little Bodies are not ſo liable to that kind of violence from whence their Motion does proceed.

As for thoſe Inſtances which are cited to illuſtrate the poſſibility of this ſwiftneſs in the Heavens, we anſwer: The paſſage of a Sound is but very ſlow in compariſon to the motion of the Heavens. And then beſides, the ſwiftneſs of the Species of Sound or Sight which are Accidents, are not fit to infer the like Celerity in a Material Subſtance: And ſo likewiſe for the Light, which * *Ariſtotle* himſelf, and with him the generality of Philoſophers, do for this very Reaſon prove not to be a Body, becauſe it moves with ſuch ſwiftneſs, of which (it ſeems) they thought a Body to be incapable. Nay, the † Objector himſelf in another place, ſpeaking of Light in reference to a Subſtance, does ſay: *Lumen eſt accidens, ſic ſpecies rei viſæ, & alia eſt ratio ſubſtantiarum, alia accidentium.*

* *De Animâ. l.* 2. *c.* 7.

† *Roſſ. l.* 2. *ſect.* 1. *c.*4.

To that of a Bullet, we anſwer: He might as well have illuſtrated the Swiftneſs of a Bullet, which will paſs 4 or 5 Miles in 2 Minutes, by the motion of a Hand in a Watch, which paſſes 2 or 3 Inches in 12 Hours; there being a greater diſproportion betwixt the motion of the Heavens, and the ſwiftneſs of a Bullet, than there is 'twixt the ſwiftneſs of a Bullet, and the Motion of a Hand in a Watch.

Another

Another Argument to this purpoſe may be taken from the chief End of the Diurnal and Annual Motions, which is to diſtinguiſh betwixt Night and Day, Winter and Summer; and ſo conſequently, to ſerve for the Commodities and Seaſons of the habitable World. Wherefore it may ſeem more agreeable to the Wiſdom of Providence, for to make the Earth as well the Efficient, as the final Cauſe of this Motion; eſpecially ſince Nature in her other Operations does never uſe any tedious difficult Means to perform that which may as well be accompliſhed by ſhorter and eaſier Ways. But now, the Appearances would be the ſame, in reſpect of us, if only this little Point of Earth were made the Subject of theſe Motions, as if the vaſt Frame of the World, with all thoſe Stars of ſuch Number and Bigneſs were moved about it. 'Tis a common Maxim, Μήδεν εἰκῇ τῶν φύσιν ἐργάζεσθαι. Nature does nothing in vain, but in all her Courſes does take the moſt compendious Way. 'Tis not therefore (I ſay) likely, that the whole Fabrick of the Heavens, which do ſo much exceed our Earth in Magnitude and Perfection, ſhould be put to undergo ſo great and conſtant a Work in the Service of our Earth, which might more eaſily ſave all that Labour by the Circumvolution of its own Body; eſpecially, ſince the Heavens do not by this Motion attain any farther Perfection for themſelves, but are made thus ſerviceable to this little Ball of Earth. So that in this Caſe it may ſeem to argue as much Improvidence in Nature to employ them in this Motion, as it would in a * Mother, who in warming her Child, would rather turn the Fire about that, than that about the Fire: Or in a † Cook, who would not roaſt his Meat by turning it about to the Fire; but rather, by turning the Fire about it: ∴ Or in a Man, who aſcending ſome high Tower, to ſave the Labour of ſtirring his Head, ſhould rather deſire that all the Regions might ſucceſſively be turned before his Eye, that ſo he might eaſily take a view of them.

Arg. 2.

Galen.

* *Lansberg.*

† *Keplar.*

∴ *Galil.*

We allow every Watchmaker ſo much Wiſdom as not to put any Motion in his Inſtrument, which is ſuperfluous, or may be ſupplied an eaſier way: And ſhall we not think that Nature has as much Providence as every ordinary Mechanick? Or can we imagine that She ſhould appoint thoſe numerous and vaſt Bodies, the Stars, to compaſs us with ſuch a ſwift and reſtleſs Motion, ſo full of Confuſion and Uncertainties, when as all this might as well be done by the Revolution of this little Ball of Earth?

Arg. 3. Amongſt the ſeveral parts of the World, there are Six Planets which are generally granted to move. As for the Sun and the Earth, and the fixed Stars, it is yet in queſtion, which of them are naturally endowed with the ſame Condition. Now common Reaſon will dictate unto us, that Motion is moſt agreeable to that which in Kind and Properties is moſt near to thoſe Bodies that undoubtedly are moved. But now there is one eminent Qualification, wherein the Earth does agree with the Planets; whereas the Sun, together with the fixed Stars, do in the ſame reſpect differ from them: And that is Light, which all the Planets, and ſo too the Earth, are fain to borrow elſewhere, whilſt the Sun and the Stars have it of their own. From whence it may be probably concluded, that the Earth is rather the Subject of this Motion than the other. To this it may be added, that the Sun and Stars ſeem to be of a more excellent Nature than the other parts of the World; and therefore ſhould in reaſon be endowed with the beſt Qualifications. But now Motion is not ſo noble a Condition as Reſt. That is but a kind of weariſome and ſervile thing; whereas, this is uſually aſcribed to God himſelf: Of whom 'tis ſaid:

* *Boet. de Conſol. Phil. l. 3. Arg.* 4.

* *Immotus ſtabiliſque manens dans cuncta moveri.*

† *De Cœlo, l. 2. c.* 10.

† *Ariſtotle* tells us, 'tis very agreeeble to Reaſon that the Time appointed for the Revolution of each Orb, ſhould be proportionable to its Bigneſs. But now this

can

can only be by making the Earth a Planet, and the Subject of the Annual and Diurnal Motions. Wherefore 'tis probable, that this does rather move than the Heavens.

According to the common *Hypotheſis*, the *Primum Mobile* will move round in a Day. *Saturn* in Thirty Years. *Jupiter* in Twelve. *Mars* in Two. The *Sun*, *Venus*, and *Mercury*, which have ſeveral Orbs, yet will agree in their Revolutions, being each of them about a Year in finiſhing their Courſes: Whereas by making the Earth a Planet, there will be a juſt Proportion betwixt the Bigneſs of the Orbs, and the time of their Motions: For then, next to the Sun or Centre, there will be the Sphere of *Mercury*; which as it is but narrow in its Diameter, ſo likewiſe is it quick in its Motion, running its Courſe in 88 Days. *Venus*, that is next unto it, in 224 Days. The Earth in 365 Days, or a Year. *Mars*, in 687 Days. *Jupiter*, in 4332 Days. *Saturn*, in 10759 Days. Thus likewiſe is it with thoſe *Medicean* Stars that encompaſs *Jupiter*. That which is loweſt amongſt them, finiſhes his Courſe in two and twenty Hours; the next in three Days and a half; the third, in ſeven Days; and the fartheſt in ſeventeen Days. Now as it is (according to *Ariſtotle's* Confeſſion) more likely that Nature ſhould obſerve ſuch a due Proportion betwixt the Heavenly Orbs; ſo is it more probable, that the Earth ſhould move, rather than the Heavens.

Arg. 5. This may likewiſe be confirmed from the Appearance of Comets: Concerning which, there are three things commonly granted, or if they were not, might be eaſily proved: Namely,

1. That there are divers Comets in the Air, betwixt the Moon and our Earth.

2. That many of theſe Comets do ſeem to riſe and ſet as the Stars.

3. That this appearing Motion is not properly their own, but communicated unto them from ſomewhat elſe.

But now, this Motion of theirs cannot be cauſed by the Heavens; and therefore it muſt neceſſarily proceed from the Revolution of our Earth.

That the Moon's Orb cannot carry along with it the greater part of the Air, wherein theſe Comets are placed, might eaſily be proved from the common Grounds. For the concave Superficies of that Sphere is uſually ſuppoſed to be exactly terſe and ſmooth; ſo that the meer touch of it cannot turn about the whole Element of Fire, with a Motion that is not natural unto it. Nor could this Elementary Fire which they imagine to be of a more rarified and ſubtle Nature, communicate the ſame Motion to the thicker Air, and that to the Waters (as ſome affirm:) For by what Means could that ſmooth Orb take hold of the adjoining Air? To this *Sarſius* anſwers, that there are great Gibboſities, and mountainous Inequalities, in the Concavity of the loweſt Sphere, and by theſe is it enabled to carry along with it the Fire and Air. But * *Fromondus* tells him, *Fictitia iſta & ad fugam reperta ſunt.* And yet his own Conjecture is ſcarce ſo good, when he affirms, that this Motion of the Æthereal Air, as alſo of that Elementary Air hard by us, is cauſed by that Ruggedneſs which there is in the Bodies of the Planets; of which Opinion we may with as good Reaſon ſay as he ſays to *Sarſius*, *Fictitia iſta & ad fugam reperta*: Theſe Things are meer Fictions invented for Shifts, and without any probable ground.

* *Antar. cap.* 16.

But now this Appearance of the Comets may eaſily be reſolved, if we ſuppoſe the Earth to move. For then, though they did ſtill remain in their wonted Places; yet this, by its diurnal Revolution ſucceſſively withdrawing it ſelf from them, they will appear to riſe and ſet. And therefore, according to this common natural Experiment, it is more probable that the Earth ſhould move, than the Heavens.

Another Argument urged by ſome to prove that this Globe of Earth is eaſily moveable, is taken from the

the Opinion of thoſe who affirm that the Acceſs of any Weight unto a new Place, as ſuppoſe an Army, does make the Earth poiſe it ſelf afreſh, and change the Centre of Gravity that it had before: But this is not generally granted; and therefore not to be inſiſted on as a common ground. *Vid. Vaſq. l. 1. diff. 2. cap. 8. 16.*

To this purpoſe likewiſe is that inference of *Lansbergius*, who from *Archimedes* his ſaying, that he could move the Earth, if he knew where to ſtand and faſten his Inſtrument; concludes, that the Earth is eaſily moveable; whereas 'twas the Intent of *Archimedes* in that Speech, to ſhew the infinite Power of Engines: There being no Weight ſo great, but that an Inſtrument might be invented to move it.

Before we finiſh this Chapter, 'tis requiſite that we enquire what kind of Faculty that is from which theſe Motions that *Copernicus* aſcribes unto the Earth, does proceed: Whether or no it be ſome Animal Power, that does aſſiſt (as *Ariſtotle*) or inform (as *Keplar* thinks,) or elſe ſome other natural motive Quality which is intrinſical unto it.

We may obſerve, That when the proper genuine Cauſe of any Motion is not obvious, Men are very prone to attribute unto that which they diſcern to be the moſt frequent Original of it in other things, Life. Thus the *Stoicks* affirm, the Soul of the Water to be the Cauſe of the ebbing and flowing of the Sea. Thus others think the Wind to proceed from the Life of the Air, whereby it is able to move it ſelf ſeveral Ways, as other living Creatures. And upon the ſame grounds do the *Platonicks*, *Stoicks*, and ſome of the *Peripateticks*, affirm the Heavens to be animated. From hence likewiſe it is, that ſo many do maintain *Ariſtotle* his Opinion concerning *Intelligences*: Which ſome of his Followers, the Schoolmen, do confirm out of Scripture. From that Place in *Mat.* 24. 29. where 'tis ſaid, *The Powers of the Heavens ſhall be ſhaken.* In which words, by *Powers* (ſay they) are meant the Angels, by whoſe Power it is, that the Heavens are moved. *Sen. Nat. Queſt. l. 5. cap. 5, 6.*

And ſo likewiſe in that, *Job* 9. 13. where the Vulgar has it, *Sub quo curvantur, qui portant orbem*; that is, the Intelligences. Which Text might ſerve altogether as well, to prove the Fable of *Atlas* and *Hercules*. Thus *Cajetan* concludes from that Place in the *Pſalm* 136. 5. where 'tis ſaid, *God by Wiſdom made the Heavens*; or according to the Vulgar, *Qui fecit Cœlos intellectu*, That the Heavens are moved by an intelligent Soul.

If we conſider the Original of this Opinion, we ſhall find it to proceed from that Miſtake of *Ariſtotle*, who thought the Heavens to be Eternal; and therefore to require ſuch a moving Cauſe, as being of an Immaterial Subſtance, might be exempted from all that Wearineſs and Inconſtancy which other things are liable unto.

But now this Ground of his is evidently falſe, ſince 'tis certain, That the Heavens had a beginning, and ſhall have an end. However, the employing of Angels in theſe Motions of the World, is both ſuperfluous, and very improbable.

1. Becauſe a natural Power, intrinſical to thoſe Bodies, will ſerve the turn as well. And as for other Operations, which are to be conſtant and regular, Nature does commonly make uſe of ſome inward Principle.

2. The Intelligences being immaterial, cannot immediately work upon a Body; nor does any one tell us what Inſtruments they ſhould make uſe of in this Buſineſs. They have not any Hands to take hold of the Heavens, or turn them about. And that Opinion of *Aquinas*, *Durand*, *Soncinas*, with other Schoolmen, ſeems to be without all Reaſon; who make the Faculty whereby the Angels move the Orbs, to be the very ſame with their Underſtandings and Will: So that if an Angel do but meerly ſuſpend the Act of willing their Motion, they muſt neceſſarily ſtand ſtill: And on the contrary, his only willing them to move, ſhall be enough to carry them about in their ſeveral Courſes: Since it were then a needleſs thing for Providence to have appointed Angels unto this Buſineſs, which

which might have been done as well by the only Will of God. And beſides, how are the Orbs capable of perceiving this Will in the Intelligences? Or if they were, yet what Motive Faculty, have they of themſelves, which can enable them to obey it?

Now as it would be with the Heavens, ſo likewiſe is it with the Earth, which may be turned about in its Diurnal Revolution, without the help of Intelligences, by ſome motive Power of its own, that may be Intrinſical unto it.

If it be yet enquired, what cauſe there is of its Annual Motion: I anſwer; 'Tis eaſily conceivable, how the ſame Principle may ſerve for both theſe, ſince they tend the ſame way from Weſt to Eaſt.

However, that Opinion of *Keplar* is not very improbable, That all the Primary Planets are moved round by the Sun, which once in Twenty five or Twenty ſix Days, does obſerve a Revolution about its own Axis, and ſo carry along the Planets that encompaſs it; which Planets are therefore ſlower or ſwifter, according to their diſtances from him. If you ask by what means the Sun can produce ſuch a Motion? He anſwers; By ſending forth a kind of Magnetick Virtue in ſtrait Lines, from each Part of its Body; of which there is always a conſtant Succeſſion: So that as ſoon as one Beam of this Vigour has paſſed a Planet, there is another preſently takes hold of it, like the Teeth of a Wheel.

But how can any Virtue hold out to ſuch a diſtance? He anſwers: Firſt, as Light and Heat, together with thoſe other ſecret Influences which work upon Minerals in the Bowels of the Earth; ſo likewiſe may the Sun ſend forth a Magnetick, Motive Virtue, whoſe Power may be continued to the fartheſt Planets. Secondly, if the Moon, according to common Philoſophy, may move the Sea, why then may not the Sun move this Globe of Earth?

In ſuch *Queries* as theſe, we can conclude only from Con-

Conjectures: That Speech of the Wise Man, *Eccles.* 3. 11. being more especially verified of *Astronomical* Questions concerning the Frame of the whole *Universe*, *That no Man can find out the Works of God, from the beginning to the end.* Though we may discern divers things in the World, which may argue the infinite Wisdom and Power of the Author, yet there will be always some Particulars left for our Dispute and Enquiry, and we shall never be able with all our Industry, to attain a perfect Comprehension of the Creatures, or to find them wholly out, *from the beginning to the end.*

Valles. Sacr. Philos. c. 64. The Providence of God having thus contrived it, that so Man might look for another Life after this, when all his Longing and Thirst shall be fully satisfied. For since no natural Appetite is in vain, it must necessarily follow, that there is a possibility of attaining so much Knowledge as shall be commensurate unto these Desires; which because it is not to be had in this World, it will behove us then to expect and provide for another.

PROP. X.

That this Hypothesis is exactly agreeable to common Appearances.

IT hath been already proved, that the Earth is capable of such a Situation and Motion as this Opinion supposes it to have. It remains, that in the last Place we shew how agreeable this would be unto those ordinary Seasons of Days, Months, Years, and all other Appearances in the Heavens.

1. As for the difference betwixt Days and Nights; 'tis evident, That this may be as well caused by the Revolution of the Earth, as the Motion of the Sun; since the Heavenly Bodies must needs seem after the same manner to rise and set, whether or no they themselves

by

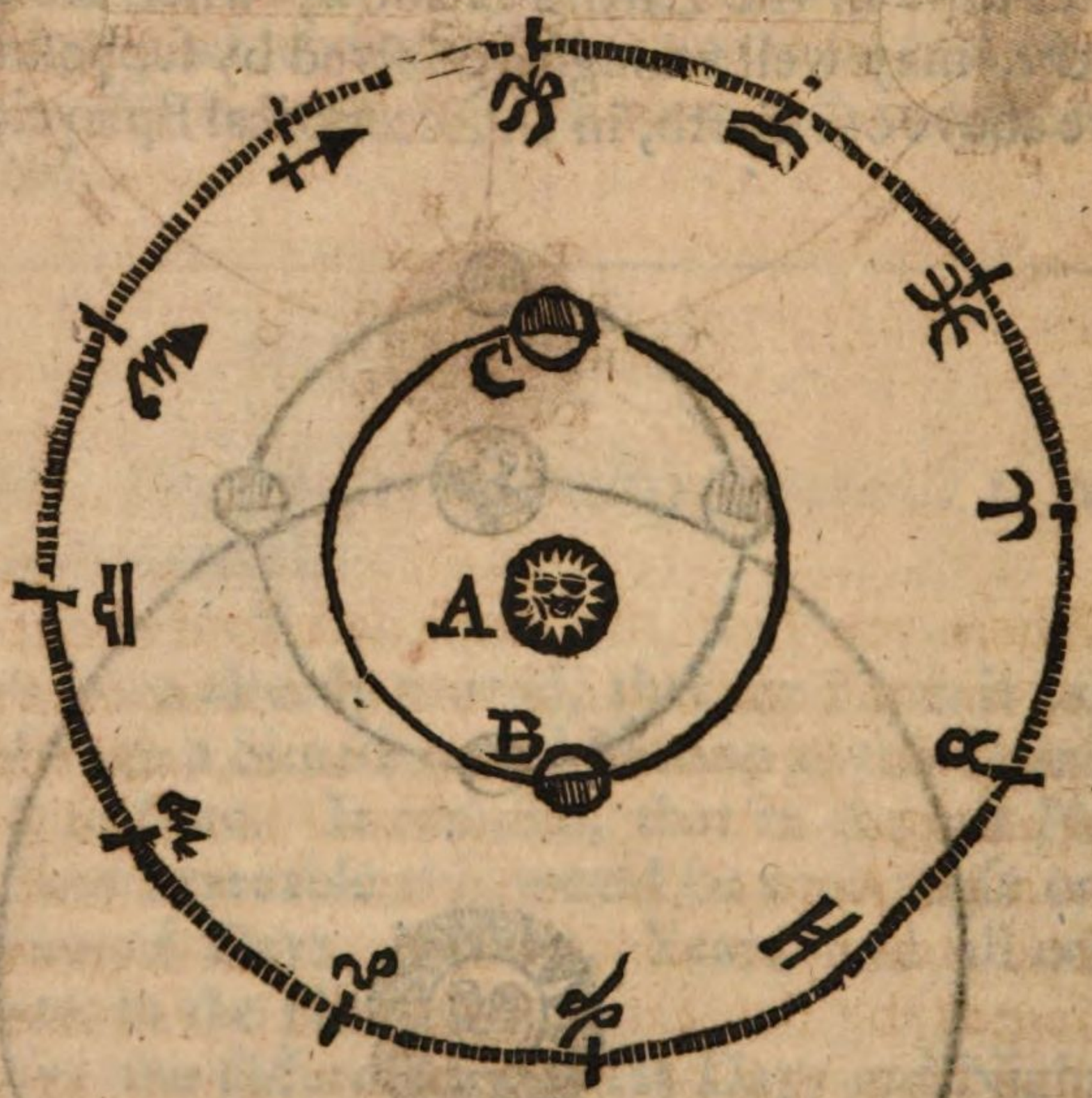
by their own Motion, do pass by our *Horizon* and *Vertical* Point; or whether our *Horizon* and *Vertical* Point, by the Revolution of our Earth, do pass by them. According to that of * *Aristotle*, ὃ δὲν διαφέρει κινεῖν τὴν ὄψιν ἢ τὸ ὁρώμενον, there will not appear any difference, whether or no the Eye be moved from the Object, or the Object from the Eye. And therefore I cannot chuse but wonder that a Man of any Reason or Sense, should make choice of no better an Argument to conclude his Book withal, than that which we read at the latter end of *Al. Rosse*, where he infers, That the Earth does not move, because then the Shadow in a Sun-Dial would not be altered.

* *De Cælo, lib.2.cap.8.*

2. As for the difference of Months, we say, That the diverse Illumination of the Moon, the different bigness of her Body, her remaining for a longer or shorter time in the Earth's Shadow, when she is Eclipsed, *&c.* may well enough be solved by supposing her to move above our Earth, in an Eccentrical Epicycle. Thus,

In which kind of *Hypotheſis*, there will be a double difference of Motion; the one cauſed by the different Situations of the Moon's Body, in its own Eccentrick; the other by the different Situations of the Moon's Orb, in the Earth's Eccentrick: Which is ſo exactly anſwerable to the Motions and Appearances of this Planet, that from hence *Lansbergius* draws an Argument for this *Syſtem* of the Heavens, which in the ſtrength of his Confidence he calls, *Demonſtrationem* ὀστρακόδερμον, *cui nulla ratione poteſt contradici.*

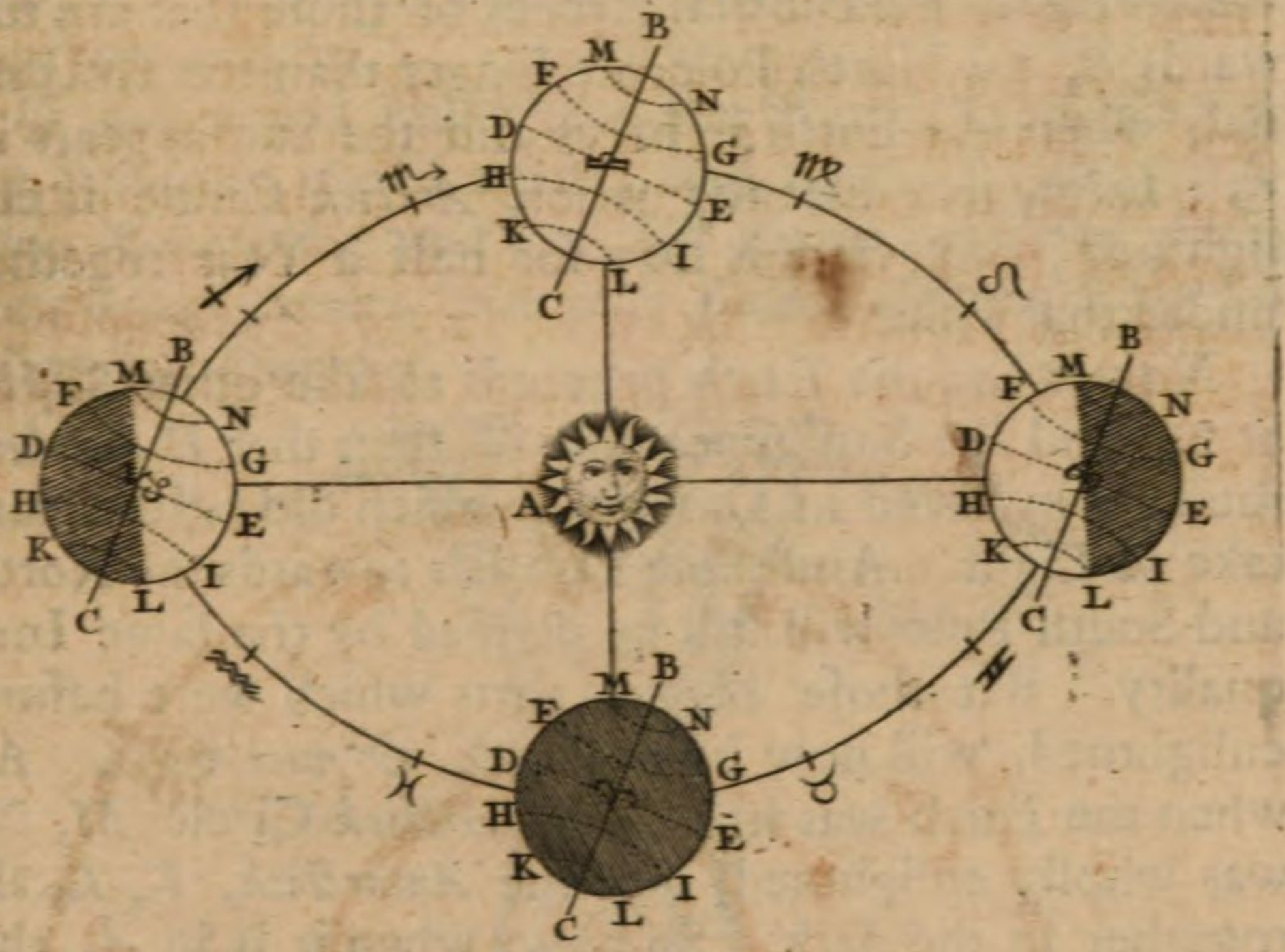
4. As for the difference betwixt Winter and Summer; betwixt the number and length of Days, which appertain to each of thoſe Seaſons; the ſeeming Motion of the Sun from one Sign to another in the *Zodiack*: All this may eaſily be ſolved, by ſuppoſing the Earth to move in an Eccentrical Orb about the Sun. Thus,



Suppoſe the Earth to be at *C*, then the Sun at *A* will ſeem to be in the Sign ♋, and at the greateſt diſtance from us, becauſe the Earth is then in the fartheſt part of its *Eccentrick*. When after by its Annual Motion it hath

hath paſſed ſucceſſively by the Signs ♒ ♓ ♈ ♉ ♊, at length it comes to the other *Solſtice* at *B*, where the Sun will appear in ♑, and ſeem biggeſt, as being in its *Perige*, becauſe our Earth is then in the neareſt part of its *Eccentrick*.

As for all other Appearances of the Sun which concern the Annual Motion, you may ſee by the following Figure, that they are exactly agreeable to this *Hypotheſis*.



Where you have the Earth deſcribed about the Sun at *A*, in the Four chief Points of the *Zodiack*; namely, the two *Equinoctials* at ♈ and ♎, and the *Solſtices* at ♑ and ♋. Through all which Points the Earth does paſs in his Annual Motion from Weſt to Eaſt.

The *Axis* upon which our Earth does move, is repreſented by the Line *B C*, which *Axis* does always decline from that of the *Ecliptick*, about 23 Degrees, 30 Minutes. The Points *B C* are imagined to be the Poles, *B* the North-Pole, and *C* the South.

Now if we ſuppoſe this Earth to turn about its own *Axis* by a Diurnal Motion, then every Point of it

will

will describe a parallel Circle, which will be either bigger or lesser, according to its distance from the Poles. The chief of them are the *Equinoctial D, E.* The two *Tropicks, F, G*; and *H, I*, the two *Polar* Circles. *M, N*, the *Arctick*, and *K, L*, the *Antarctick*; of which the *Equinoctial* only is a great Circle, and therefore will always be equally divided by the Line of Illumination *M, L*, whereas the other Parallels are thereby distributed into unequal parts. Amongst which parts, the Diurnal Arches of those that are towards *B*, the North Pole, are bigger than the Nocturnal, when our Earth is in ♈ and the Sun appears in ♎: Insomuch, that the whole *Arctick* Circle is enlightned, and there is Day for half a Year together under that Pole.

Now when the Earth proceeds to the other *Solstice* at ♎, and the Sun appears in ♈, then that *Hemisphere* must be involved in Darkness, which did before partake of Light. And those Parallels towards the North and South Poles will still be divided by the same Inequality. But those bigger parts which were before enlightned, will now be darkned, *& vice versa*. As when the Earth was in *N*, the *Arctick* Circle *M, N*, was wholly enlightned, and the *Antarctick, K, L*, altogether in the dark. So now, when it is in *A*, the *Antarctick K, L*, will be wholly in the Light, and the other *M, N*, altogether obscured. Whereas the Sun before was vertical to the Inhabitants at the *Tropick F, G*; so now is he in the same Situation to those that live under the other *Tropicks, H, I*. And whereas before the Pole did incline 23 Degrees 30 Minutes towards the Sun, so now does it decline as much from him. The whole difference will amount to 47 Degrees, which is the distance of one *Tropick* from the other.

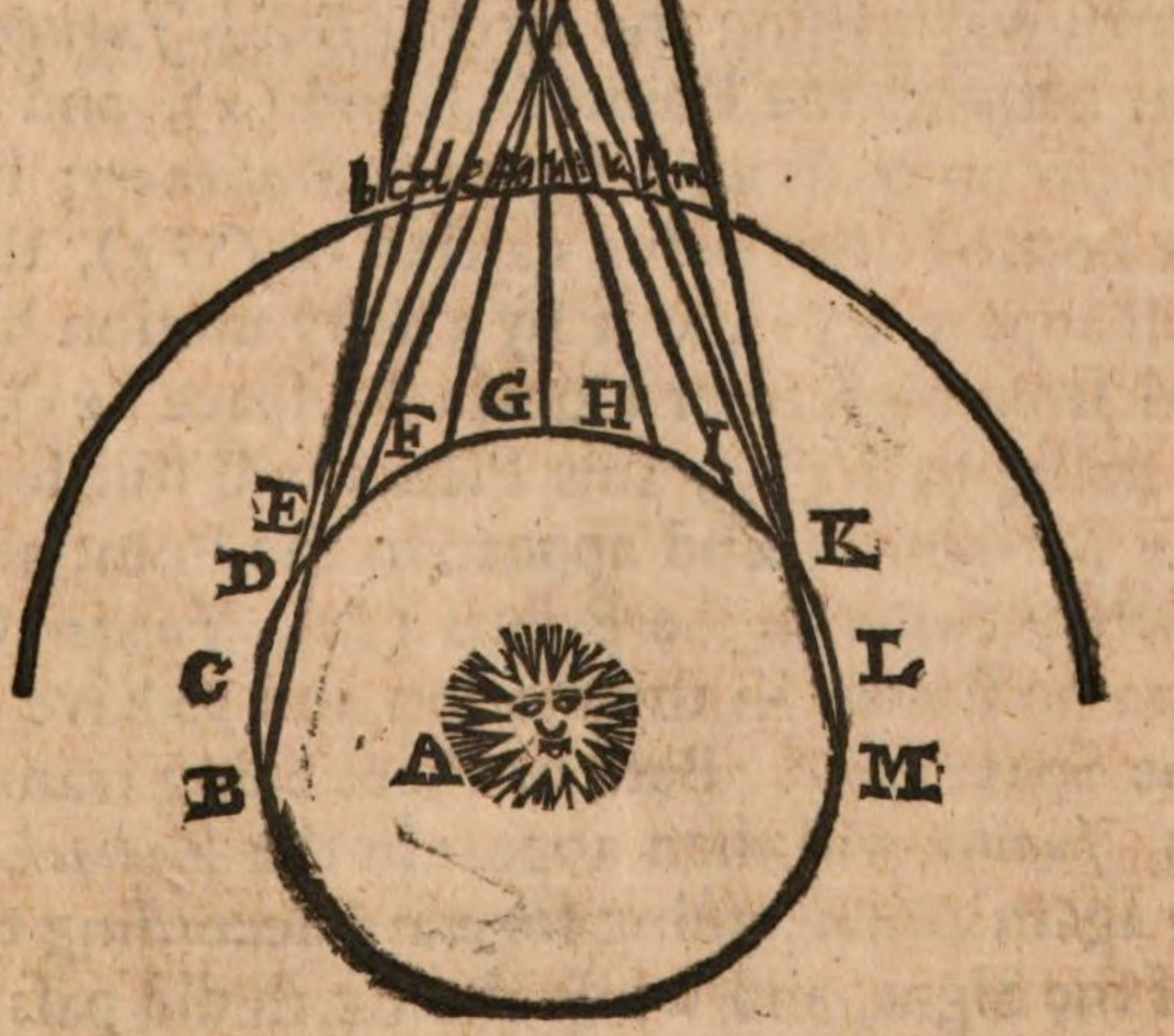
But now in the two other Figures, when the Earth is in either of the *Equinoctials* ♈ ♎, the Circle of Illumination will pass thro' both the Poles, and therefore must

muſt divide all the Parallels into equal Parts. From whence it will follow, that the Day and Night muſt then be equal in all places of the World.

As the Earth is here repreſented in ♎, it turns only the enlightned part towards us: As it is in ♈ we ſee its Nocturnal *Hemiſphere.*

So that according to this *Hypotheſis*, we may eaſily and exactly reconcile every Appearance concerning the difference betwixt Days and Nights, Winter and Summer, together with all thoſe other Varieties which depend upon them.

If you would know how the Planets (according to the *Syſtem* of the Heavens) will appear *Direct*, *Stationary*, *Retrograde*; and yet ſtill move regularly about their own Centers, you may plainly diſcern it by this following *Diagram.*



Where

Where ſuppoſe the Sun to be at *A*, the Circle (*B*, *G*, *M*,) to be the Orb of the Earth's Motion, and that above it noted with the ſame Letters, to be the Sphere of *Jupiter*; and the uppermoſt of all, to be a part of the *Zodiack* in the Starry Heaven.

Now if you conceive the Letters *A B C D E F G H I K L M*, and *b c d e f g b i k l m*, to divide the Earth's Orb and that of *Jupiter*, into ſeveral parts, proportionable to the ſlowneſs or ſwiftneſs of their different Motions (*Jupiter* finiſhing his Courſe in 12 Years, and the Earth in one) then ſuppoſing the Earth to be at the Point (*B*) and *Jupiter* likewiſe in his Orb to be ſituated at (*b*), he will appear unto us to be in the *Zodiack* at the Point (*r*). But afterwards both of them moving forwards to the Letter (C c.) *Jupiter* will ſeem to be in the *Zodiack* at (*v*), as having paſſed directly forward according to the Order of the Signs. And ſo likewiſe each of them being transferred to the places (*D d*) (*E e*) *Jupiter* will ſtill appear *Direct*, and to have moved in the *Zodiack* unto the Points (*y z*). But now when the Earth comes to be more immediately interpoſed betwixt this Planet and the Sun; as when both of them are at the Letter (*F f*) then will *Jupiter* be diſcerned in the *Zodiack* at (*x*). So that all the while the Earth was paſſing the Arch (*E F*) *Jupiter* did ſtill remain betwixt the Points (*z*) and (*x*), and therefore muſt ſeem unto us as if he were *Stationary*; but afterwards both of them being carried to (*G g*), then *Jupiter* will appear at (*s*), as if by a haſty motion he had returned from his former Courſe the ſpace (*x s*). Both of them paſſig to (*H b*), this Planet will ſtill ſeem to be ſwiftly *Retrograde*, and appear in the Point at (*p*), but when they come to the Points (*I i*), *Jupiter* will then ſeem to be ſlower in this motion, and to have only paſſed the Space (*p n*). Both of them being transferred to (*K k*), *Jupiter* will then appear in the *Zodiack* at (*o*) as being again *Direct*, going forward according to the order of the Signs, and while the Earth did paſs the Arch

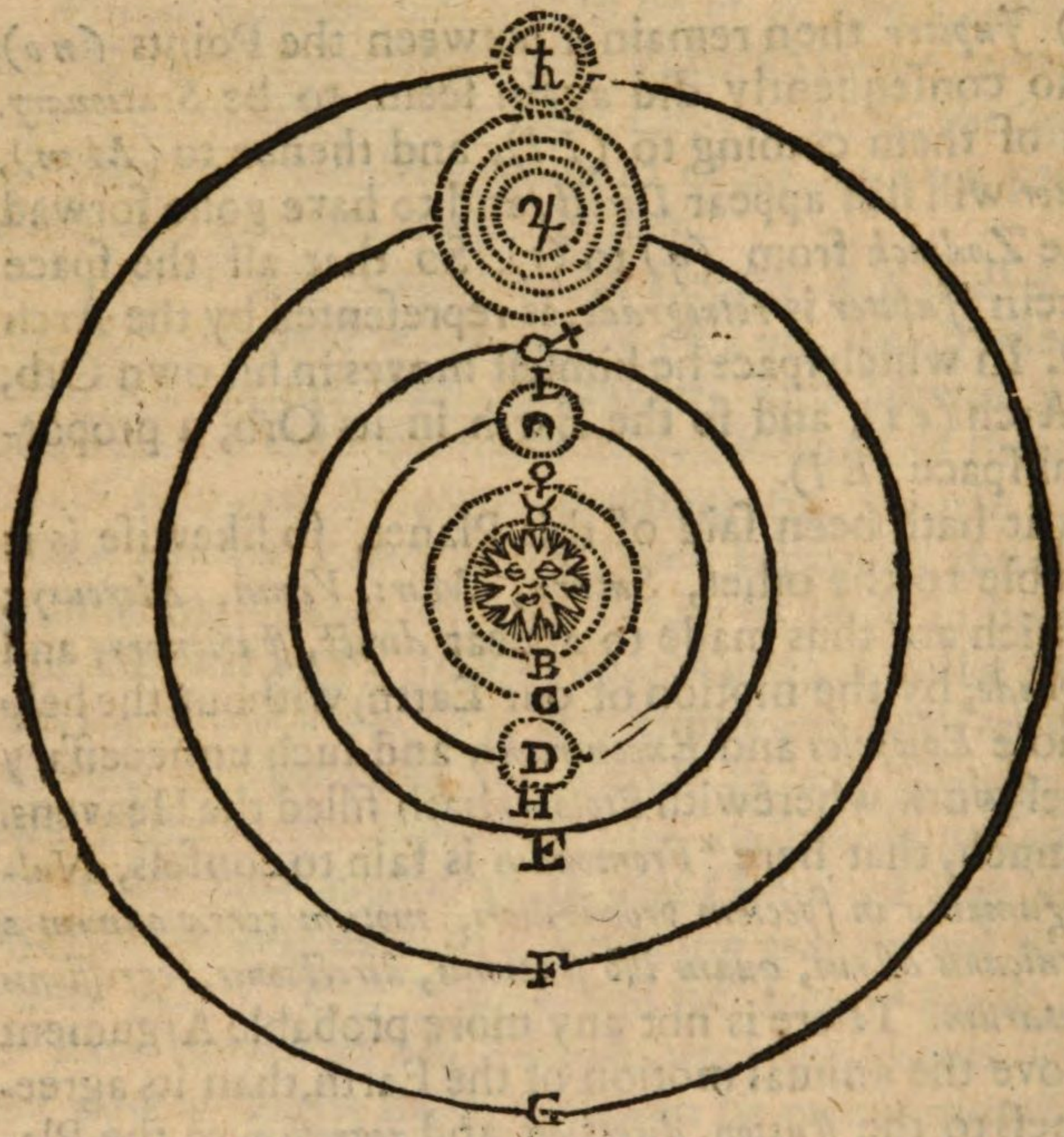
(*I K*)

(*l K*) *Jupiter* then remain'd between the Points (*n o*), and ſo conſequently did again ſeem to be *Stationary*. Both of them coming to (*L l*), and thence to (*M m*), *Jupiter* will ſtill appear *Direct*, and to have gone forwad in the *Zodiack* from (*q*) to (*t*). So that all the ſpace wherein *Jupiter* is *retrograde*, is repreſented by the Arch (*n z*). In which ſpace he himſelf moves in his own Orb, the Arch (*e i*), and ſo the Earth in its Orb, a proportional ſpace (*E I*).

As it hath been ſaid of this Planet, ſo likewiſe is it appliable to the other, *Saturn*, *Mars*, *Venus*, *Mercury*; all which are thus made to appear *direct*, *ſtationary*, and *retrograde*, by the motion of our Earth, without the help of thoſe *Epicycles* and *Excentricks*, and ſuch unneceſſary Wheel-work, wherewith *Ptolomy* hath filled the Heavens. Inſomuch, that here * *Fromondus* is fain to confeſs, *Nullo Argumento in ſpeciem probabiliori, motum terræ annum a Copernicanis aſtrui, quam illo ſtationis, directionis, regreſſionis Planetarum.* There is not any more probable Argument to prove the annual motion of the Earth, than its agreeableneſs to the *ſtation*, *direction*, and *regreſſion* of the Planets.

* *Antariſt. c.* 18. *Veſt. tract.* 4. *c.* 3.

Laſtly, That *Copernicus*'s Syſtem of the Heavens is very anſwerable to the exacteſt Obſervations, may be manifeſt from this following Deſcription of it.



Suppoſe the Sun to be ſituated at *A*: Now becauſe *Mercury* is found by experience to be always very near the Sun, ſo that he does for the moſt part lye hid under his Rays; as alſo becauſe this Planet hath a more lively vigorous Light than any of the other; therefore we may infer, that his Orb is placed next unto the Sun, as that at *B*.

As for *Venus*, 'tis obſerv'd, That ſhe does always keep at a ſet diſtance from the Sun, never going from him above 40 Degrees, or thereabouts; that her Body appears thro' the Perſpective to be forty times bigger at one time than at another; that when ſhe ſeems biggeſt and neareſt unto us, we then diſcern her as being perfectly round. Therefore doth this Planet alſo move in a Circle that encompaſſes the Sun. Which Circle does not contain the Earth within it; becauſe then *Venus* would ſometimes be in *oppoſition* to the Sun; whereas

'tis

'tis generally granted, that she never yet came so far as to be in a *Sextile*.

Nor is this Circle below the Sun (as *Ptolomy* supposeth) because then this Planet, in † both its Conjunctions, would appear horned, which she does not.

† *Matutina Vespertina.*

Nor is it above the Sun, because then she would always appear in the Full, and never horned.

From whence it will follow, that this Orb must necessarily be betwixt the Earth and the Sun, as that at *C*.

As for *Mars*, 'tis observ'd, that he does appear sixty times bigger when he is near us, than at his greatest distance; that he is sometimes in opposition to the Sun. From whence we may conclude that his Orb does contain our Earth within it. 'Tis observed also, that he does constantly appear in the Full, and never Horned: From whence likewise it is manifest, that the Sun is comprehended within its Orb, as it is in that which is represented by the Circle *E*.

And because the like Appearances are observ'd in *Jupiter* and *Saturn* (tho' in less Degrees) therefore we may with good Reason conceive them to be in the Heavens, after some such manner as they are here set down in the Figure, by the Circles *F. G*.

As for the Moon, because she is sometimes in *opposition* to the Sun, therefore must her Orb comprehend in it the Earth; because she appears dark in her Conjunction, and sometimes eclipses the Sun; therefore that must necessarily be without her Orb, as it is in that *Epicycle* at *H*. In the Center of which, the Earth must necessarily be situated, according to all those Appearances mention'd before. So that the Orb of its annual motion will be represented by the Circle *D*.

All which Appearances cannot so well be reconciled by *Ptolomy*, *Tycho*, *Origanus*, or by any other *Hypothesis*, as by this of *Copernicus*. But the application of these to the several Planets, together with sundry other Particulars, concerning the *Theorical* part of *Astronomy*, you may see more fully set down by those who have pur-

posely handled this Subject, *Copernicus*, *Rhetichus*, *Galilæus*; but more especially *Keplar*: Unto whom I do acknowlede my self indebted for sundry Particulars in this Discourse.

I have done with that which was the chief Purpose of the present Treatise; namely, the removal of those Common Prejudices that Men usually entertain against this Opinion. It remains, that by way of Conclusion, I endeavour to stir up others unto these kind of Studies, which by most Men are so much neglected.

'Tis the most rational way, in the prosecution of several Objects, to proportion our Love and Endeavour after every thing, according to the excellency and desirableness of it. But now amongst all Earthly Contentments, there is nothing either better in it self, or more convenient for us, than this kind of Learning; and that, whether you consider it according to its *General* Nature, as a *Science*; or according to its more *Special* Nature, as *such* a *Science*.

1. Consider it as a *Science*. Certain it is, that amongst the variety of Objects, those are more eligible which conduce unto the Welfare of that which is our best part, our Souls. 'Tis not so much the pleasing of our Senses, or the increasing of our Fortunes, that does deserve our Industry, as the Information of our Judgments, the Improvement of our Knowledge. Whatever the World may think, yet it is not a vast Estate, a Noble Birth, an Eminent Place, that can add any thing to our true real Worth; but it must be the degrees of that which makes us *Men*, that must make us *better Men*, the Endowments of our Soul, the Enlargement of our Reason. Were it not for the Contemplation of Philosophy, the Heathen * *Seneca* would not so much as thank the Gods for his Being: *Nisi ad hæc admitterer non fuit opere pretium nasci. Detrahe hoc inestimabile bonum non est vita tanti, ut sudem, ut æstuem.* Take but away this Benefit, and he would not think Life worth the sweating for. So much Happiness could he discern in the Studies of Nature. And therefore as a *Science* in general, it may very well deserve our Love and Industry.

* *Præf. ad l. 1. Nat. Quest.*

2. Consider it as such a particular *Science*, *Astronomy*: the Word signifies the Law of the Stars; and the *Hebrews* (who do not ordinarily admit of Composition) call it in two Words, חקות שמים *Cælorum Statuta*, or the *Ordinances of Heaven*; because they are governed in their Courses by a certain Rule, as the *Psalmist* speaks in the 148th *Psal.* v. 6. *God has given them a Law which shall not be broken.*

Job 38. 33. *Jer.* 33. 25.

Now this of all other Natural *Sciences* may best of all challenge our Industry; and that, whether you consider it,

1. Absolutely, as it is in it self: Or,
2. As it stands in reference to us.

1. As it is in it self. The Excellency of any *Science* may be judged of (saith the Philosopher) first, by the Excellency of the Object. Secondly, by the Certainty of its Demonstrations.

1. For

1. For the *Object*. It is no leſs than the whole World (ſince our Earth alſo is one of the Planets) more eſpecially thoſe vaſt and glorious Bodies of the Heavens. So that in this reſpect it far exceeds all thoſe barren, empty Speculations about *Materia prima*, and *Univerſale*, and ſuch like Cobwebs of Learning; in the ſtudy of which ſo many do miſplace their younger Years. And for the ſame Reaſon likewiſe is it to be preferr'd before all thoſe other *Sciences*, whoſe Subjects are not either of ſo wide an Extent, or ſo excellent a Nature.

2. For the *Demonſtrations* of *Aſtronomy*, they are as infallible as Truth it ſelf; and for this Reaſon alſo does it excel all other Knowledge, which does more depend upon Conjectures and Uncertainty. They are only thoſe who want Skill in the Principles of this *Science*, that miſtruſt the Concluſions of it. Since therefore in theſe reſpects, it is one of the moſt Excellent *Sciences* in Nature, it may beſt deſerve the Induſtry of Man, who is one of the beſt Works of Nature Other Creatures were made with their Heads and Eyes turned downwards: Would you know why Man was not created ſo too? why it was, that he might be an *Aſtronomer*.

Os homini ſublime dedit, Celumq; tueri
Juſſit, & erectos ad Sydera tollere vultus.
God gave to Man an Upright Face, that he
Might view the Stars, and learn *Aſtronomy*.

2. Conſider it in reference to us; and ſo it is,

1. Moſt Uſeful.
2. Moſt Pleaſant.

1. Moſt Uſeful, and that in ſundry reſpects. It proves a God and a Providence, and incites our Hearts to a greater Admiration and Fear of his Omnipotency. *We may underſtand by the Heavens, how much mightier he is that made them; for by the Greatneſs and Beauty of the Creatures, proportionably the Maker of them is ſeen*, ſaith the Book of *Wiſdom*, 13. 4, 5. It was hence that *Ariſtotle* did fetch his Chief Argument to prove a *Primus Motor*. 'Twas the conſideration of theſe Things that firſt led Men to the Knowledge and Worſhip of God (ſaith * *Tully*). *Hæc nos primum ad Deorum cultum, tum ad modeſtiam, magnitudinemq; animi erudivit.* And therefore when God by the Prophet would convince the People of his Deity, he bids them *lift up their Eyes on high, and behold who hath created thoſe things; that bringeth out their Hoſt by number, that calleth them all by their Names*, &c. Iſa. 40. 26. Which occaſion'd that Saying of *Lactantius*; *Tanta rerum magnitudo, tanta diſpoſitio, tanta in ſervandis ordinibus, temporibuſq; conſtantia; non potuit aut olim ſine provido artifice oriri, aut conſtare tot ſæculis ſine incola potente, aut perpetuum gubernari ſine perito & ſciente rectore, quod ratio ipſa declarat.* Such a great Order and Conſtancy amongſt thoſe vaſt Bodies, could not at firſt be made but by a Wiſe Providence, nor ſince preſerved without a Powerful Inhatant, nor ſo perpetually governed without a skilful Guide. True

* *Tuſcul.* 1. *Item. Plut. deplacit. Phil. l.* 1. *c.* 6.

Inſtit. l. 2. *c.* 5.

True indeed, an ordinary View and common Apprehenſion of theſe Celeſtial Bodies, muſt needs manifeſt the Excellency and Omnipotency of their Maker; but yet a more accurate and diligent Enquiry into their Natures, will raiſe our Underſtandings unto a nearer Knowledge, and a greater Admiration of the Deity: As it is in thoſe inferior things, where the meer outſide of a Man, the Comelineſs and Majeſty of his Countenance, may be ſome Argument from whence to infer the Excellency of his Creator. But yet the ſubtle Anatomiſt, who ſearches more deeply into this wonderful Structure, may ſee a clear Evidence for this in the Conſideration of the inward Fabrick, the Muſcles, Nerves, Membranes, together with all thoſe ſecret Contrivances in the Frame of this little World. Thus alſo is it in the great *Univerſe*, where the common Apprehenſion of Things is not at all conſiderable, in compariſon to thoſe other Diſcoveries, which may be found out by a more exact Enquiry.

As this Knowledge may conduce to the proving of a God, and making Men Religious; ſo likewiſe may it ſerve to confirm unto us the Truth of the Holy Scriptures: Since the Sacred Story, in the order of its Narrations, does ſo exactly agree with the Converſions of Heaven, and *Logiſtical Aſtronomy*.

*Pſal.*8,3.6. It may alſo ſtir us up to behave our ſelves anſwerably unto the Noble and Divine Nature of our Souls. *When I conſider the Heaven, the Works of thy Fingers, the Moon and the Stars which thou haſt ordained, what is Man, that thou art ſo mindful of him?* as to create ſuch vaſt Glorious Bodies for his Service.

* *Sen. Nat. Quæſt. l.* 1. *Nonne ô terrena animalia conſideratis, quibus præſidere videamini? Nam ſi inter mares videres unum aliquam, jus ſibi ac poteſtatem præ cæteris vindicentem, quanto movereris chachinno,* &c. *Boetius de Conſol. l.* 2.

Again, when I conſider with my ſelf the ſtrange Immenſity and Bigneſs of this great *Univerſe*, in compariſon to which, this Earth of ours is but as an undiſcernible Point: When I conſider that I carry a Soul about me, of far greater Worth than all this, and Deſires that are of a wider Extent, and more unbounded Capacity than this whole Frame of Nature; then, methinks, it muſt needs argue a Degenerateneſs and Poverty of Spirit, to buſy my Faculties about ſo ignoble, narrow a Subject as any of theſe Earthly things. What a Folly is it in Men to have ſuch high Conceits of themſelves, for ſome ſmall Poſſeſſions which they have in the World above others; to keep ſo great a Buſtle about ſo poor a Matter? * *Hoc eſt punctum quod inter tot gentes ferro & igni dividitur.* 'Tis but a little Point which with ſo much ado is diſtributed unto ſo many Nations by Fire and Sword. What great Matter is it to be Monarch of a ſmall part of a Point? Might not the Ants as well divide a little Mole-hill into divers Provinces, and keep as great a ſtir in diſpoſing of their Government? *Punctum eſt illud in quo navigatis, in quo bellatis, in quo regna deſponitis.* All this place wherein we War, and Travel, and diſpoſe of Kingdoms, is but a Point far leſs than any of thoſe ſmall Stars, that at this diſtance are ſcarce diſcernible. Which when the Soul does ſeriouſly meditate upon, it will begin to deſpiſe the narrowneſs of its

its preſent Habitation, and think of providing for it ſelf a Manſion in thoſe wider Spaces above; ſuch as may be more agreeable to the Nobleneſs and Divinity of its Nature.

Why ſhould any one Dream of propagating his Name, or ſpreading his Report through the World? When although he had more Glory than Ambition can hope for, yet as long as all this Habitable Earth is but an inconſiderable Point, what great Matter can there be in that Fame which is included within ſuch ſtrait contracted Limits? *Boetius*

Quicunq; ſolam mente præcipiti petit *Ibid.*
Summumq; credit gloriam,
Late patentes ætheris cernat plagas,
Arctumq; terrarum ſitum.
Brevem replere non valentis ambitum,
Pudebit aucti nominis.

" He that to Honour only ſeeks to mount,
" And that his chiefeſt End doth count;
" Let him behold the largeneſs of the Skies,
" And on the ſtrait Earth caſt his Eyes;
" He will deſpiſe the Glory of his Name,
" Which cannot fill ſo ſmall a Frame.

Why ſhould any one be taken up in the Admiration of theſe lower Outſides, theſe Earthly Glories? *Reſpicite Cæli ſpatium, firmitudinem, celeritatem, & aliquando definite vilia mirari.* He that rightly underſtands the Nature of the Heavens, will ſcarce eſteem any other thing worth his *Notice*, much leſs his *Wonder*. *Idem lib. 3.*

Now when we lay all this together, That he who hath moſt in the World, hath almoſt nothing of it: That the Earth it ſelf, in compariſon to the *Univerſe* is but an inconſiderable Point; and yet that this whole *Univerſe* does not bear ſo great a proportion to the Soul of Man, as the Earth does unto that. I ſay, when a Man in ſome retired Thoughts ſhall lay all this together, it muſt needs ſtir up his Spirits to a contempt of theſe Earthly Things, and make him place his Love and Endeavour upon thoſe Comforts that may be more anſwerable to the Excellency of his Nature.

Without this Science, what Traffick could we have with Foreign Nations? What would become of that mutual Commerce, whereby the World is now made but as one Commonwealth.

Voſque mediis in aquis Stellæ, pelagoque timendo.
Decretum monſtraſtis iter, totique dediſtis,
Legibus inventis hominum, commercia mundo.
'Tis you Bright Stars, that in the fearful Sea,
Do guide the Pilot through his purpos'd Way.
'Tis your Direction that doth Commerce give,
With all thoſe Men that thro' the World do live.

2. As this Science is thus profitable in theſe and many other reſpects; ſo likewiſe is it equally pleaſant. The Eye (ſaith the Philoſopher) is the Senſe of Pleaſure, and there are no Delights

lights ſo pure and immaterial as thoſe which enter through that Organ. Now to the Underſtanding, which is the Eye of the Soul, there cannot be any fairer Proſpect, than to view the whole Frame of Nature, the Fabrick of this great *Univerſe*, to diſcern that Order and Comelineſs which there is in the *Magnitude*, *Situation*, *Motion* of the ſeveral Parts that belong unto it; to ſee the true Cauſe of that conſtant Variety and Alteration which there is in the different Seaſons of the Year. All which muſt needs enter into a Man's Thoughts with a great deal of Sweetneſs and Complacency. And therefore it was that *Julius Cæſar* in the Broils and Tumult of the Camp, made choice of this Delight:

Wiſ.7.18, 19.

Lucan l.10.

——Media inter prælia ſemper,
Stellarum, Cælique plagis, ſuperiſque vacavit.
He always leiſure found amidſt his Wars,
To mark the Coaſts of Heav'n, and learn the Stars.

And for this reaſon likewiſe did *Seneca*, amidſt the continual Noiſe and Buſtle of the Court, betake himſelf to this Recreation.

O quam juvabat, quo nihil majus, parens
Natura genuit, operis immenſi artifex,
Cælum intueri Solis, & currus ſacros
Mundique motus, Solis alternas vices,
Orbemque Phœbes, aſtra quem cingunt vaga
Lateque fulgens Ætheris magni decus.
O what a Pleaſure was it to ſurvey
Nature's chief Work, the Heavens; where we may
View the alternate Courſes of the Sun,
The Sacred Chariots; how the World does run:
The Moon's bright Orb, when She's attended by
Thoſe ſcatter'd Stars, whoſe Light adorns the Sky.

And certainly thoſe eminent Men who have this way beſtowed a great Part of their Employment, ſuch as were *Ptolomy*, *Julius Cæſar*, *Alphonſus* King of *Spain*, the Noble *Tycho*, &c. have not only by this Means pitched upon that which for the preſent was a more ſolid kind of Pleaſure and Contentment; but alſo a ſurer way to propagate their Memories unto future Ages. Thoſe great coſtly Pyramids which were built to perpetuate the Memory of their Founders, ſhall ſooner periſh and moulder away into their Primitive Duſt, than the Names of ſuch Worthies ſhall be forgotten. The Monuments of Learning are more durable than the Monuments of Wealth or Power.

All which Encouragements may be abundantly enough to ſtir any conſidering Man, to beſtow ſome part of his Time in the Study and Inquiſition of theſe Truths.

Fœlices animæ, quibus hæc cognoſcere primum,
Inque domos ſuperas ſcandere cura fuit.

Mercury:

Mercury:

OR THE

Secret and Swift

Messenger.

SHEWING,

How a Man may with *Privacy* and *Speed* communicate his *Thoughts* to a Friend at any Distance.

The Third Edition.

By the Right Reverend Father in God, *JOHN WILKINS*, late Lord Bishop of *CHESTER*.

LONDON:

Printed for *John Nicholson* at the *King's-Arms* in *Little Britain*; *Benj. Tooke* at the *Middle Temple Gate* in *Fleetstreet*; *And. Bell* at the *Cross Keys and Bible* in *Cornhill*; and *Ralph Smith* under the *Piazza* of the *Royal-Exchange*. MDCCVII.

To the Right Honourable

GEORGE,

Lord *Berkley*, Baron of *Berkley*, *Mobray*, *Segrave*, and *Bruce*, and Knight of the Noble Order of the *Bath*.

My Lord,

I *Do here once more present your Lordship with the Fruit of my* leisure *Studies, as a Testimony of my Readiness to serve you in those sacred Matters, to which I devote my more se-*rious *Hours. I should not have presumed to this Dedication, had I not been encouraged by that generousness and sweetness of Disposition, which does so eminently adorn your Lordship's Place and Abilities.*

If your Lordship please to excuse this Boldness, and to vouchafe this Pamphlet a shelter under your favourable Patronage, you shall thereby encourage me in those higher Studies, which may be more agreeable to that Relation wherein I stand, as being

Your Lordship's Servant and Chaplain,

J. W.

To the READER.

THat which first occasion'd this Discourse, was the reading of a little Pamphlet, stiled, *Nuntius Inanimatus*, commonly ascribed to a late Reverend Bishop; wherein he affirms, That there are certain Ways to discourse with a Friend, though he were in a close Dungeon, in a besieged City, or a Hundred Miles off.

Which Promises, at the first Perusal, did rather raise my Wonder than Belief, having before that time observed nothing that might give any Satisfaction in these Particulars. And I should have esteemed them altogether Fabulous, had it not been for the Credit of their reputed Author.

After this, I did collect all such Notes to this Purpose, as I met with in the Course of my other Studies.

From whence when I had received full Satisfaction, I did for mine own farther Delight compose them into this Method.

I have already attained mine own Ends, both in the Delight of Composing this, and the Occasion of Publishing it: And therefore need not either fear the Censure of others, or beg their Favour. I could never yet discern, that any Reader hath shewed the more Charity for the Author's bespeaking it. Farewell.

J. W.

To MERCURY *the Elder*:

On the moſt Learned *Mercury* the Younger.

REST Maja's *Son, ſometimes Interpreter*
Of gods, and to us Men their Meſſenger:
Take not ſuch Pains as thou haſt done of old,
To teach Men Hieroglyphicks, *and to unfold*
Egyptian *hidden Characters, and how*
Men writ in dark Obſcurity: For now
Trithemius *and* Selenus *both are grown*
Such Cryptographers, *as they ſcarce will own*
Thee for their Maſter; and Decipherers know
Such ſecret Ways to write, thou ne'er didſt ſhow.
Theſe are but Artiſts which thou didſt inſpire;
But now thou of a Mercury *art Sire*
Of thine own Name, a Poſt with whom the Wind,
Should it contend, would be left far behind.
Whoſe Meſſage, as thy Metal, ſtrikes the Gold
Quite through a Wedge of Silver uncontrol'd;
And in a moment's ſpace doth paſs as far
As from the Artick *to th'* Antartick *Star.*
So proving what is ſaid of Influence,
May now be ſaid of his Intelligence,
They neither of them having ſuch a Quality
As a relation to Locality:
No Places diſtance hindring their Commerce,
Who freely traffick through the Univerſe;
And in a minute can a Voyage make
Over the Ocean's univerſal Lake.
This Son of thine, could any Words or Praiſe,
His Learning, Worth, or Reputation raiſe,

We ſhould be Suitors to him to beſtow
Encomiums *on* Himſelf, *which* We *do owe*
Unto his Worth, and uſe that Eloquence,
Which as his own, muſt claim Prebeminence:
For thee, 'tis Glory enough thou haſt a Son
Of Art, that hath thy ſelf in Art outdone.

Sir *Francis Kinaſton*, Knt.

To the Unknown Author.

OF Old, who to the common Good apply'd
Or Mind or Means, for it were Deifi'd:
But chiefly ſuch who new Inventions found;
Bacchus *for Wine,* Ceres *that till'd the Ground.*
I know no reaſon Time ſhould breed ſuch odds,
(W' have warrant for't) Men now may be ſtil'd gods.
By hiding who thou art, ſeek not to miſs
The Glory due to ſuch a Work as this;
But ſet thy Name, that thou may'ſt have the Praiſe,
Leſt to the Unknown God *we Altars raiſe.*

Anthony Aucher, *Eſq;*

To my Friend the Author.

TO praiſe thy Work, were to anticipate
Thy Reader's Judgment, and to injure Fate;
Injuſtice to thy ſelf; for real Worth
Needs not Arts Flattery to ſet it forth.
Some chuſe ſelected Wits *to write as* Friends,
Whoſe Verſes, when the Work fails, make amends.
So as the Buyer has his Pennyworth,
Though what the Author write prove ſpumy Froth.

Thou

Thou, of a Humour croſs to that, haſt choſe
A Friend or two, whoſe Verſe hops like rough Proſe;
From whoſe inexpert Vein thou canſt not look
For Lines that may enhance the Price o'th' Book.
Let it commend it ſelf, all we intend
Is but to ſhew the World thou art our Friend.

Richard Hatton, *Eſq;*

To the Reader.

READer, this Author has not long ago
Found out another World to this below:
Though that alone might merit great Renown,
Yet in this Book he goes beyond the Moon:
Beyond the Moon *indeed, for here you ſee*
That he from thence hath fetch'd down Mercury;
One that doth tell us Things both ſtrange *and* new,
And yet believe't they're not more ſtrange than true.
I'm loth to tell thee what rare Things they be,
Read thou the Book, and then thou'lt tell them me.

Tob. Worlrich, *J. C. Doct.*

To his Honoured Friend J. W. *on his Learned Tract,* The Secret and Swift Meſſenger.

INimitable Sir, we here diſcern
Maxims the Stagirite *himſelf might learn.*
Were Plato *now alive he'd yield to you,*
Confeſſing ſomething might be Known anew.
Freſh Hereſies (New-nothings) ſtill appear
As Almanacks, *the Births of every Year.*

This Dutchman *writes a* Comment; *that* Tranſlates;
A third Tranſcribes; *Your Pen alone* Creates
New neceſſary Sciences: This Art
Lay undiſcover'd as the World's Fifth Part.
But Secreſy's *now publiſh'd; You reveal*
By Demonſtration how we may conceal.
Our Legates *are but Men, and often may*
Great State-Affairs unwillingly betray;
Caught by ſome ſifting Spies, or tell-tale Wine,
Which dig up Secrets in the deepeſt Mine.
Sometimes, like Fire pent in, they outward break,
And 'cauſe they ſhould be ſilent, therefore ſpeak.
Nor are King's Writings ſafe: To guard their Fame,
Like Scævola *they wiſh their Hand i'th' Flame.*
Ink turns to Blood; they oft participate
By Wax and Quill ſad Icarus *his Fate.*
Hence Noblemens bad Writing proves a Plot;
Their Letters are but Lines, their Names a Knot.
But now they ſhall no more Seal *their own* Fall;
No Letters prove Killing, *or* Capital.
Things paſs unknown, and each Ambaſſador's
Strict as the Breaſt of Sacred Confeſſors:
Such as the Inquiſition cannot ſee;
Such as are forc'd neither by Rack, nor Fee.
Swift Secrecy deſcends to Human Powers;
That which was Pluto's *Helmet, now is Ours.*
We ſhall not henceforth be in pay for Air,
Tranſported Words being dear as precious Ware;
Our Thoughts will now arrive before they're ſtale;
They ſhall no more wait on the Carriers *Ale*
*And Hoſteſs, two Land-*Remoraes, *which bind*
All to a Tortoiſe *pace, though Words be Wind.*
This Book's a better Ark; we brook no ſtay,
Maugre the deepeſt Flood, or fouleſt Way.
Commerce of Goods and Souls we owe to Two,
(Whoſe Fames ſhall now be Twins) Noah *and You.*
h Bird is turn'd a Parrot, *and we ſee*
's Beaſts made more eloquent by thee.

Wooers

Wooers again may wing their fetter'd Love,
By Noah's *truſty Meſſenger the* Dove.
Torches which us'd only to help our Sight,
(Like Heavenly Fires) do give our Reaſon Light.
Deaths Harbingers, Arrows, and Bullets prove
Like Cupid's *Darts, Ambaſſadors of Love.*
Then your Diviner Hieroglyphicks *tell,*
How we may Landskips read, and Pictures ſpell.
You teach how Clouds *inform, how Smoaks adviſe;*
Thus Saints with Incenſe talk to Deities.
Thus by dumb Creatures we inſtructed are,
As the Wiſe Men were tutor'd by a Star.
Since we, true Serpents like, do little wrong
With any other Member but the Tongue;
You tell us how we may by Geſtures talk;
How Feet are made to ſpeak, as well as walk;
How Eyes diſcourſe, how myſtick Nods contrive;
Making our Knowledge too, Intuitive.
A Bell no noiſe but Rhetorick *affords;*
Our Muſick Notes are Speeches, Sounds are Words.
Without a Trope there's Language in a Flow'r,
Conceits are ſmelt without a Metaphor.
Dark Subtleties we now ſhall ſoon define,
Each Organ's *turn'd the Senſe of* Diſcipline.
'Tis to your Care *we owe that we may ſend*
Buſineſs unknown to any but our Friend.
That which is Engliſh *Friendſhip to my Brother,*
May be thought Greek *or Nonſenſe to another.*
We now may Homer's Iliads *confine,*
Not in a Nut-ſhell, but a Point, or Line.
Which Art though't ſeem to exceed Faith, yet who
Tries it will find both Truth and Reaſon too.
'Tis not like Fugglers Tricks, abſurd, when ſhown;
But more and more admir'd, the more 'tis known.
Writing's an Act of Emanation,
And Thoughts ſpeed quick and far as Day doth run.

Richard Weſt. C. C. Ox.

THE

The CONTENTS.

CHap. I. *The Dependance of this Knowledge in Nature. The Authors that have treated of it. Its Relation to the Art of Grammar.*

Chap. II. *The Conditions requiſite to Secreſy: The Uſe of it in the Matter of Speech, either by Fables of the Heathen; or Parables of Scripture.*

Chap. III. *Concerning that Secreſy of Speech, which conſiſts in the Words, either by inventing new ones, as in Canting, or Conjuring. Or by changing of the known Language, whether Inverſion, Tranſmutation, Diminution, or Augmentation.*

Chap. IV. *Concerning the Secret Conveyances of any written Meſſage in Uſe amongſt the Ancients, either by Land, Water, or the open Air.*

Chap. V. *Of that Secreſy which conſiſts in the Materials of Writing, whether the Paper or the Ink.*

Chap. VI. *Secret Writing with the common Letters, by changing of their Places.*

Chap. VII. *Concerning ſecret Writing with equal Letters, by changing their Powers. The Uſe of this amongſt the* Jews *and* Romans. *The Key-Character.*

Ch. VIII. *Of Secret Writing by more Letters than are requiſite to the intended meaning.*

Chap. IX. *Of concealing any written Senſe under barbarous Words, and ſuch as ſhall not ſeem to be of any Signification. How all the Letters may be expreſſed by any five, three, or two of them. Of Writing with a double Alphabet. How from theſe two laſt Ways together, there may be contrived the beſt kind of Secret Writing.*

Chap. X. *Of Writtng any Secret Senſe by fewer Letters than are required to the Words of it. The Uſe of this amongſt the* Jews *and* Romans.

Chap. XI. *Of Writing by invented Characters. The Diſtinction of theſe into ſuch as ſignify, either Letters, Words or Notions. The general Rules of unfolding and obſcuring any Letter-character. How to expreſs any Senſe, either by Points, or Lines, or Figures.*

Chap. XII. *Of Characters that expreſs Words. The firſt Invention of theſe. Of thoſe that ſignify Things and Notions, as Hieroglyphicks, and Emblems.*

Chap. XIII. *Concerning an Univerſal Character, that may be legible to all Nations and Languages. The Benefit and Poſſibility of this.*

Chap. XIV. *Concerning the third Way of Secret Diſcourſing by Signs and Geſtures, which may ſignify either* ex congruo, vel placito.

Chap. XV. *Concerning the Swiftneſs of Informations, either by Qualities, as the Impreſſion of Imagination, and the Senſitive Species; or by Spiritual Subſtances, as Angels.*

Chap. XVI. *Concerning the Swiftneſs of Conveyance by Bodies, whether Inanimate, as Arrows, Bullets; or Animate, as Men, Beaſts, Birds,*

Chap. XVII. *Of Secret and Swift Informations by the Species of Sound.*

Chap. XVIII. *Concerning a Language that may conſiſt only of Tunes and Muſical Notes, wihout any articulate Sound.*

Chap. XIX. *Of thoſe common Relations that concern Secret and Swift Informations by the Species of Sight, which are either Fabulous, or Magical.*

Chap. XX. *Of Informations by ſignificatory Fires and Smoaks. Their Antiquity. The true manner of Uſing them to this Purpoſe. That theſe were meant in* Nuncius Inanimatus.

MER-

MERCURY,

THE

Secret and Swift Messenger.

CHAP. I.

The Dependance of this Knowledge in Nature. The Authors that have treated of it. Its Relation to the Art of Grammar.

EVery rational Creature, being of an imperfect and dependent Happiness, is therefore naturally endowed with an Ability to communicate its own Thoughts and Intentions; that so by mutual Services, it might the better promote it self in the Prosecution of its own Well-being.

And because there is so vast a Difference betwixt a Spirit and a Body, therefore hath the Wisdom of Providence contrived a distinct Way and Means, whereby they are each of them enabled to Discourse, according to the Variety of their several Natures.

The Angels or Spiritual Substances, *Per insinuationem specierum*, (as the Schoolmen speak.) By insinuating of the Species, or an unveiling of their own Natures in the Knowledge of such Particulars as they would discover to another. And since they are of an *Homogeneous* and *immaterial* Essence, there-

Aquinas part 1. *Quæst.* 107. *Zanch. de Operibus Dei, part* 1. *l.* 3. *c.* 19.

fore

fore do they hear, and know, and speak, not with several parts, but with their whole Substance. And tho' the Apostle mentions the *Tongue of Angels*, yet that is only *Per concessionem, & ex hypothesi.*

1 Cor. 13. 1.

But now, *Men* that have *Organical Bodies*, cannot communicate their Thoughts so easie and immediate a way. And therefore have need of some Corporeal Instruments, both for the *Receiving* and *Conveying* of Knowledge. Unto both which Functions, Nature hath designed several Parts. Amongst the rest, the Ear is chiefly the Sense of Discipline or *Learning*, and the Tongue the Instrument of *Teaching*. The Communion betwixt both these, is by Speech or Language, which was but one at first, but hath since been confounded into several kinds. And Experience now shews, that a Man is equally disposed for the Learning of all, according as Education shall direct him. Which would not be, if (as some fondly conceive) any one of them were Natural unto us. For *Intus existens prohibet alienum.*

Vallesius Sacr. Phil. cap. 3.

*Cæl. Rhod. Ant. lect. l.*2.9.*c.* 14.

Or suppose that a Man could be brought up to the Speaking of another Tongue, yet this would not hinder, but that he should still retain his Knowledge of that which was Natural. For if those which are gotten by Art do not hinder one another, much less would they be any impediment to that which is from Nature. And according to this it will follow, that most men should be of a double Language, which is evidently false. Whence likewise you may guess at the Absurdity of their Enquiries, who have sought to find out the Primitive Tongue, by bringing up Infants in such silent solitary Places, where they might not hear the Speech of others.

Languages are so far Natural unto us, as other Arts and Sciences. A Man is born without any of them, but yet capable of all.

Now, because *Words* are only for those that are present both in *Time* and *Place*; therefore to these

there

there hath been added, the Invention of *Letters* and Writing, which are such a Representation of our Words (tho' more permanent) as our Words are of our Thoughts. By these we may discourse with them that are remote from us, not only by the Distance of many Miles, but also of many Ages. *Hujus usu scimus maxime constare humanitatem vitæ, memoriam, ac hominum immortalitatem,* saith *Pliny*. *Quid hoc magnificentius? Quid æque mirandum? in quod ne mortis quidem avida rapacitas jus ullum habeat,* saith *Rhodiginus*. This being the chiefest Means both for the promoting of Human Society, and the perpetuating our Names unto following Times.

Nat. Hist. l.14. c.11. Antiq lect. l. 4. c. 3.

How strange a thing this Art of Writing did seem at its first Invention, we may guess by the late discovered *Americans*, who were amazed to see Men converse with Books, and could scarce make themselves believe that a Paper should speak; especially, when after all their Attention and listning to any Writing (as their Custom was) they could never perceive any Words or Sound to proceed from it.

There is a pretty Relation to this Purpose, concerning an *Indian* Slave; who being sent by his Master with a Basket of Figs and a Letter, did by the Way eat up a great Part of his Carriage, conveying the Remainder unto the Person to whom he was directed; who when he had read the Letter, and not finding the Quantity of Figs answerable to what was spoken of, he accuses the Slave of eating them, telling him what the Letter said against him. But the *Indian* (notwithstanding this Proof) did confidently abjure the Fact, cursing the Paper, as being a false and lying Witness. After this, being sent again with the like Carriage, and a Letter expressing the just Number of Figs that were to be delivered, he did again, according to his former Practice, devour a great Part of them by the Way; but before he

Hermannus Hugo de Orig. Scribendi Præf.

he meddled with any, (to prevent all following Accusations) he first took the Letter, and hid that under a great Stone, assuring himself, that if it did not see him eat the Figs, it could never tell of him; but being now more strongly accused than before, he confesses the Fault, admiring the Divinity of the Paper, and for the future does promise his best Fidelity in every Employment.

Such strange Conceits did those wilder Nations entertain, concerning this excellent Invention. And doubtless it must needs argue a vast Ability both of Wit and Memory in that Man who did first confine all those different Sounds of Voice, (which seem to be almost of infinite Variety) within the Bounds of those few Letters in the Alphabet.

Cic. l. 3. de Nat. Deor. Polyd. Vir. de Inventor. l. 1. c. 6. Vossius de Grammatica, l. 1. c. 9. Natal. Comes Mytho. l. 5. c. 5.

The first Inventor of this was thought to be the *Egyptian Mercury*, who is therefore stiled the *Messenger* of the Gods. To which purpose the Poets have furnished him with Wings for *Swiftness* and dispatch in his Errands. And because the Planet of that Name was thought to observe a more various and obscure Revolution than any of the rest, therefore likewise did they attribute unto him such *Secret* and subtle Motions, as might make him a trusty and private Messenger, and so the fitter for that Preferment to which for this Invention they had advanced him.

There is yet another way of Discoursing, by Signs and Gestures; and though it be not so common in *Practice* as either of the other, yet in *Nature* perhaps it is before them both, since Infants are able this way to express themselves, before they have the Benefit of Speech.

But now, because none of these ways in ordinary Use, are either so *Secret* or *Swift* as some Exigencies would require; therefore many of the Ancients have busied themselves in a further Enquiry, how both these Deficiencies may be remedied; as conceiving

ceiving that such a Discovery would be of excellent Use, especially for some Occasions that are incident to *Statesmen* and *Soldiers.*

That the Ignorance of *Secret* and *Swift* Conveyances, hath often proved Fatal, not only to the Ruin of particular Persons, but also of whole Armies and Kingdoms, may easily appear to any one that is but little versed in Story. And therefore the redressing of these may be a Subject worth our Enquiry.

Amongst the Ancients that have most laboured in these Particulars, † *Æneas*, *Cleomenes*, and *Democritus*, (as they are cited by * *Polybius*) were for their Inventions of this kind, more remarkably eminent. And that ∴ Author himself hath given us such an exact Relation of the Knowledge of Antiquity in these things, that 'tis a wonder these following Ages should either take no more notice, or make no more use of it. Besides these, there is also *Julius Africanus*, and *Philo Mechanicus*, two Ancient *Grecians*, who have likewise treated of this Subject.

† *Poliorcetica.*
* *Hist. l.* 10.
∴ *Polybius, ib. juxta finem.*

The Military Significations in use amongst the *Romans*, are handled by † *Vegetius* and * *Frontinus.*

† *De re milit. l.* 3. *c.* 5.
* *De Strat.*

Their Notes of Secresy, and Abbreviation in Writing, are largely set down by * *Valerius Probus*, and *Pet. Diaconus.* There is likewise a Volume of these set forth by *Janus Gruterus*, which for their first Invention are commonly ascribed unto *Cicero* and * *Seneca.*

* *L. de notis antiquus.*
* *The Father.*

In latter times these particulars have been more fully handled by the Abbot [a] *Trithemius*, [b] *Theodorus Bibliander*, [c] *Baptista Porta. Cardan.* Subtil. *l.* 17. *de Var.* C. 12. 6. [d] *Isaac Casaubon*, [f] *Johannes Walchius*, [e] *Gustavus Selenus*, [h] *Gerardus Vossius*, [i] *Hermannus Hugo*, and divers others in particular Languages.

[a] *L. de Polygraph. item de Stenograph.*
[b] *Tract. de ratione commun. linguarum.*
[c] *Lib. de Zyphris.*
[d] *Notis in Æneæ Polyorcetica.*
[f] *Fab.* 9. [g] *de Cryptog.* [h] *de Gram. L.* 1. *c.* 40. [i] *L. de Or. Scrib. de Augm. Scientiar. l.* 6. *c.* 1.

Amongst

Amongst the rest, our *English Aristotle*, the Learned *Verulam*, in that Work truly stiled the *Advancement* of *Learning*, hath briefly contracted the whole Substance of what may be said in this Subject. Where he refers it to the Art of *Grammar*, noting it as a deficient Part. And in reference to this is it handled by most of those Authors who have treated of it.

That Art, in its true Latitude comprehending a Treaty, concerning all the Ways of Discourse, whether by Speech, or by Writing, or by Gesture, together with the several Circumstances pertaining to them. And so this Subject belongs to the *Mint* of Knowledge; Expressions being currant for Conceits, as Money is for Valuations.

Ibid. Now as it will concern a Man that deals in Traffick, to understand the several kinds of Money, and that it may be framed of other Materials besides Silver and Gold: So likewise does it behove them who profess the Knowledge of Nature or Reason, rightly to apprehend the several Ways whereby they may be expressed.

So that besides the Usefulness of this Subject for some special Occasions, it doth also belong unto one of the Liberal Arts.

From which Considerations we may infer, that these particulars are not so trivial, as perhaps otherways they would seem; and that there is sufficient motive to excite any Industrious Spirit unto a further Search after them.

In this following Discourse I shall enquire,

1. Concerning the *Secresy* of Means, whereby to communicate our Thoughts.

2. Concerning their *Swiftness*, or quick passing at any great Distance.

3. How they may be both joined together in the Conveyance of any Message.

In the Prosecution of which, I shall also mention

(be-

(besides the true Discoveries) most of those other ways, whether *Magical*, or *Fabulous*, that are received upon common Tradition.

CHAP. II.

The Conditions requisite to Secresy: *The use of it in the* Matter *of Speech, either*

By { *Fables of the Heathen.* / *Parables of Scripture.*

TO the Exactness of Secresy in any way of Discourse, there are these two Qualifications requisite.

1. That it be difficult to be unfolded, if it should be doubted of, or examined.

2. That it be (if possible) altogether devoid of Suspicion; for so far as it is liable to this, it may be said to come short in the very Nature of Secresy; siece what is once suspected, is exposed to the Danger of Examination, and in a ready way to be discover'd; but if not, yet a man is more likely to be disappointed in his Intentions, when his Proceedings are mistrusted.

Both these Conditions together are to be found but in few of the following Instances; only they are here specified, to shew what a Man should aim at, in the Inventions of this Nature.

The Art of secret Information in the General, as it includes all significatory Signs, may be stiled *Cryptomeneses*, or private Intimations.

The particular Ways of Discourfing, were before intimated to be threefold.

1. By Speaking.

2. By Writing.
3. By Signs or Gestures.

According to which Variety, there are also different Ways of Secresy.

1. *Cryptologia.*
2. *Cryptographia.*
3. *Semæologia.*

Cryptologia, or the Secresy of Speaking, may consist either,

1. In the Matter.
2. In the Words.

1. In the *Matter* : When the thing we would utter is so concealed under the Expression of some other Matter, that it is not of obvious Conceit. To which purpose are the *Metaphors*, *Allegories*, and divers other Tropes of Oratory ; which, so far as they concern the *Ornament* of Speech, do properly belong to *Rhetorick* ; but as they may be applied for the *Secresy* of Speech, so are they reducible unto this Part of *Grammar.*

To this likewise appertains all that *ænigmatical* Learning, unto which not only the Learned Heathen, but their Gods also were so much devoted, as appears by the strange and frequent Ambiguities of the *Oracles* and *Sybils.* And those were counted the most profound Philosophers amongst them, who were best able for the Invention of such affected Obscurities.

Of this kind also were all those mysterious *Fables*, under which the Ancients did veil the Secrets of their *Religion* and *Philosophy*, counting it a Prophane Thing to prostitute the hidden Matters of either, unto Vulgar Apprehension. *Quia sciunt inimicam esse naturæ, apertam nudamque expositionem sui ; quæ, sicut vulgaribus hominum sensibus, intellectum sui, vario rerum tegmine operimentoque subtraxit, ita à prudentibus arcana sua voluit per fabulosa tractari* , saith *Macrobius.* The Gods and Nature would not themselves have hidden

Fables.

In Somn. Scip. Lib. 1. *Cap.* 2.

so

so many things from us, if they had intended them for common Understandings, or that others should treat of them after an easy and perspicuous Way: Hence was it that the Learned Men of former times were so generally inclined to involve all their Learning, in obscure and mysterious Expressions. Thus did the *Egyptian* Priests, the *Pythagoreans*, *Platonicks*, and almost all other Sects and Professions.

Parables.

And to this general Custom of those Ages (we may guess) the Holy Ghost does allude, in the frequent *Parables* both of the Old and New Testament. *Parabola est sermo similitudinarius, qui aliud dicit, aliud significat*, saith *Aquinas*. It is such a Speech of Similitude, as says one thing and means another. The Disciples do directly oppose it to plain speaking, *Behold now speakest thou plainly, and no Parables.*

Commen. in Isai. 14.

John 16. 29.

And elsewhere 'tis intimated, that our Saviour did use that Manner of Teaching for the *Secresy* of it: That those proud and perverse Auditors, who would not apply themselves to the Obedience of his Doctrine, might not so much as understand it. *To whom it is not given to know the mysteries of the Kingdom of God, to them all things are done in Parables, that seeing they may see and not perceive, and hearing they may hear and not understand.*

Mat. 13. 10, 11. Mark 4. 11, 12.

The Art of these was so to imply a secret Argument, that the Adversary might unawares be brought over to an Acknowledgement and Confession of the thing we would have. Thus did *Nathan* unexpectedly discover to *David*, the Cruelty and Injustice of his Proceedings in the Case of *Uriah*. Thus did another Prophet make *Ahab* condemn himself, for suffering the King of *Syria* to escape. And by this means did our Saviour in the Parable of the Vineyard, and the unjust Husbandman, force the unbelieving *Jews* to a secret Acknowledgment of those Judgments they had themselves deserved.

Glos. Phil. l. 2. par. 1. Tract. 2. Sect. 5.

2 Sam. 12.

1 Kings 20. 39. Mat. 21. 31.

Of this Nature was that Argument of an ancient *Orator*, who when the Enemies had propoſed Peace, upon this Condition, that the City ſhould baniſh their Teachers and Philoſophers, he ſteps up and tells the People a Tale, of certain Wars betwixt the Wolves and the Sheep, and that the Wolves promiſed to make a League, if the Sheep would put away their Maſtiff-Dogs. By this means better inſtructing them of the Danger and Madneſs there would be, in yeilding to ſuch a Condition.

The *Jewiſh* Doctors do generally in their *Talmud*, and all their other Writings, accuſtom themſelves to a Parabolical Way of Teaching; and 'tis obſerved, that many of thoſe horrid Fables that are fathered upon them, do ariſe from a Miſapprehenſion of them in this particular: Whilſt others interpret that according to the *Letter*, which they intended only for the *Moral*. As that which one *Rabby* relates, concerning a Lyon in the Foreſt of *Elay*, that at the diſtance of Four hundred Leagues, did with his Roaring ſhake down the Walls of *Rome*, and make the Women Abortive. Wherein he did not affirm the Exiſtence of any ſuch Monſter, but only intimate the Terribleneſs and Power of the Divine Majeſty. But this by the way.

Scickard Examen Commen. Rabbin diſ. 7.

By this Art many Men are able in their ordinary Diſcourſes, ſo ſecretly to convey their Counſels, or Reproofs, that none ſhall underſtand them, but thoſe whom they concern. And this way of teaching hath a great Advantage above any other, by reaſon it hath much more Power in exciting the Fancy and Affections. Plain Arguments and Moral Precepts barely propoſed, are more flat in their Operation, not ſo lively and perſwaſive, as when they ſteal into a Man's Aſſent, under the Covert of a Parable.

To be expert in this particular, is not in every Man's Power; like Poetry, it requires ſuch a Natural

tural Faculty as cannot be taught. But so far as it falls under the Rules and Directions of Art, it belongs to the Precepts of *Oratory*.

In the General 'tis to be observed, That in these Cases a Man must be very careful to make Choice of such a Subject, as may bear in it some proper Analogy and Resemblance to the chief Business. And he must before-hand in his Thoughts, so aptly contrive the several Parts of the Similitude, that they may fitly answer unto those particular Passages which are of greatest Consequence.

CHAP. III.

Concerning that Secresy of Speech, which consists in the Words, Either

By inventing new ones, as in { *Canting.* / *Conjuring.*

Or by a changing of the known Language, whether { *Inversion.* / *Transmutation.* / *Diminution.* / *Augmentation.*

THe secret Ways of Speaking, which consist in the Matter of Discourse, have been already handled. Those that are in the Words are Twofold. Either,

1. By inventing new Words of our own, which shall signifie upon compact.

2. Or by such an Alteration of any known Language, that in Pronunciation it shall seem as obscure, as if it were altogether barbarous.

To the first kind we may refer the *Canting* of Beggars; who though they retain the common Parti-

cles, yet have impoſed new Names upon all ſuch Matters as may happen to be of greateſt Conſequence and Secreſy.

And of this Nature the Charms of Witches, and Language of Magicians ſeem to be. Though of theſe it may well be doubted, whether they have any Signification at all. And if they have, whether any underſtand them, but the Devil himſelf. 'Tis probable he did invent ſuch horrid and barbarous Sounds, that by them he might more eaſily delude the weak Imaginations of his credulous Diſciples. *Martinus de Arles*, an Archdeacon in *Navar*, ſpeaking of a Conjuring-book, that was found in a Pariſh under his Viſitation, repeats out of it theſe Forms of Diſcourſing with the Devil. *Conjuro te per ælim, per ælion, per ſeboan, per adonay, per allelujah, per tanti, per archabulon*, &c. And a little after, *Sitis allegati & conſtricti per iſta ſancta nomina Dei, Hir, ælli, habet, ſat, mi, filiſgæ, adrotiagundi, tat, chamiteram*, &c. And in another Place, *Coriſcion, Matatron, Caladafon, Ozcozo, Yoſiel*, &c.

Tract. de ſuperſtitionibus.

In which Forms the common Particles and Words of uſual Senſe, are plainly ſet down in ordinary *Latin*; but many of the other, which ſeem to have the greateſt Efficacy, are of ſuch ſecret Senſe, as I think no Linguiſt can diſcover.

The Inventions of this kind do not fall under any particular Rule or Maxim, but may be equally Infinite to the Variety of articulate Sounds.

The ſecond Way of Secreſy in Speech, is by an Alteration of any known Language, which is far more eaſie, and may prove of as much Uſe for the Privacy of it, as the other. This may be performed Four Ways.

Porta de furi. lit. l. 1. cap. 5. Selenus de Cryptographia, l. 2. cap. 1.

1. By *Inverſion*, when either the *Letters* or *Syllables* are ſpelled backwards.

Mitto tibi M E T U L A S *cancros imitare legendo*, where the Word S A L U T E M is expreſſed by an Inver-

Inversion of the Letters. Or as in this other Example, *Stisho estad, veca biti*, which by an Inversion of the Sylables, is *Hostis adest, cave tibi.*

2. By *Transmutation*, or a mutual changing of one Letter for another in Pronunciation; answerable to that Form of Writing, mentioned in the Seventh Chapter. And tho this may seem of great Difficulty, yet Use and Experience will make it easie.

3. By *Contracting* some Words, and leaving Part of them out; pronouncing them after some such Way as they were wont to be both Written and Printed in ancient Copies. Thus $\bar{a}$ $\bar{a}$ stands for *anima*, *Arl's* for *Aristoteles.* But this can be but of small Use in the *English* Tongue, because that does consist most of *Monosylables.*

4. By *Augmenting* Words with the Addition of other Letters. Of which kind is that secret Way of Discoursing in ordinary Use, by doubling the Vowels that make the Sylables and interposing G. or any other Consonant, *K. P. T. R.* &c. or other Sylable s, as *Porta lib.* 1. *cap.* 5. *de furtiv. liter. notis.* Thus if I would say, *Our Plot is discovered*, it must be pronounced thus, *Ougour plogot igis digiscogovegereged.* Which does not seem so obscure in Writing, as it will in Speech and Pronunciation. And it is so easie to be learnt, that I have known little Children, almost as soon as they could speak, discourse to one another as fast this Way, as they could in their plainest *English.*

But all these latter kinds of Secresy in Speech, have this grand Inconvenience in them, that they are not without Suspicion. Cha 18. p. 17.

There are some other Ways of Speaking by inarticulate Sounds, which I shall mention afterwards.

CHAP. IV.

Concerning the Secret Conveyances of any written Message in Use amongst the Ancients.

Either by { *Land.* / *Water.* / *The open Air.*

THe Secresy of any written Message may consist either in the { *Conveyance.* / *Writing.*

1. In the *Conveyance*, when a Letter is so closely concealed in the Carriage of it, as to delude the Search and Suspicion of the Adversary. Of which kind the Ancient Historians do furnish us with divers Relations, reducible in the General unto these three Heads. Those that are

1. By Land.
2. By Water.
3. Through the open Air.

1. By Land. 1. The secret Conveyances by Land, may be of numberless variety; but those ancient Inventions of this Nature, which to my Remembrance are most obvious and remarkable, are these.

That of *Harpagus* the *Mede* (mentioned by *Herodotus* and *Justin*) who when he would exhort *Cyrus* to a Conspiracy against the King his Uncle, (and not daring to commit any such Message to the ordinary Way of Conveyance, especially since the King's Jealousy had stopped up all Passages with Spies and Watchmen) he puts his Letters into the Belly of a Hare, which, together with certain Hunters Nets, he delivered unto a trusty Servant, who under this Disguise of a Huntsman, got an unsuspected Passage to *Cyrus*. And *Astyages* himself was by

Herod. l. 1. *cap.* 123. *Justin. l.* 1.

by this Conspiracy bereaved of that Kingdom which was then the greatest Monarchy in the World.

To this Purpose likewise is that of *Demaratus* King of *Sparta*, who being banished from his own Country, and received in the *Persian* Court, when he there understood of *Zerxes* his Design and Preparation for a War with *Greece*, he used these means for the Discovery of it unto his Countrey-men. Having writ an Epistle in a * Tablet of Wood, he covered over the Letters with Wax, and then committed it unto a trusty Servant, to be delivered unto the Magistrates of *Lacedæmon*; who, when they had received it, were for a long time in a perplexed Consultation what it should mean; they did see nothing written, and yet could not conceive but that it should import some weighty Secret; till at length the King's Sister did accidentally discover the Writing under the Wax: By which means the *Grecians* were so well provided for the following War, as to give a Defeat to the greatest and most numerous Army that is mentioned in History.

Justin. l. 2. See the like related of *Hamucar. Ib. l.* 21.

* Such as formerly they were wont to write upon, whence the Phrase *Rasa Tabula*, and *litera a litura*.

The Fathers of the Council of *Ephesus*, when *Nestorius* was condemned, being strictly debarred from all ordinary Ways of Conveyances, were fain to send unto *Constantinople* by one in the Disguise of a Beggar.

Isaac. Casa. Notis in Æneæ Polior. c. 31.

Some Messengers have been sent away in Coffins as being dead: Some others in the Disguise of Brute Creatures, as those whom *Josephus* mentions in the Siege of *Jotapata*, who crept out of the City by Night like Dogs.

De Bello Judaic. l. 3. *c.* 8.

Others have conveyed Letters to their imprisoned Friends, by putting them into the Food they were to receive, which is related of *Polycrita*. *Laurentius Medices* involving his Epistles in a Piece of Bread, did send them by a certain Nobleman in the Form of a Beggar. There is another Relation of one, who rolled up his Letters in a Wax-candle, bidding the Messenger tell the Party that was to receive it, that the

Herm. Hugo de Orig. Scrib. c. 15. *Solemn. de Cryptographia, l.* 8. *c.* 7.

the Candle would give him Light for his Business. There is yet a stranger Conveyance spoken of in *Æneas*, by Writing on Leaves, and afterwards with these Leaves covering over some sore or putrid Ulcer, where the Enemy would never suspect any secret Message.

Poliorcet. c. 31.

Others have carried Epistles inscribed upon their own Flesh, which is reckoned amongst those secret Conveyances mentioned by *Ovid.*

De Arte Amand.

Caveat hoc custos, pro charta, conscia tergum
Præbeat, inque suo corpore verba ferat.

But amongst all the ancient Practices in this kind, there is none for the Strangeness, to be compared unto that of *Hystiæus*, mentioned by *Herodotus*, and out of him in *Aulus Gellius*; who whilst he resided with *Darius* in *Persia*, being desirous to send unto *Aristagoras* in *Greece*, about revolting from the *Persian* Government, (concerning which they had before conferred together) but not knowing well how at that Distance to convey so dangerous a Business with sufficient Secresy, heat length contrived it after this Manner: He chose one of his Household-Servants that was troubled with sore Eyes, pretending that for his Recovery his Hair must be shaved, and his Head scarified; in the Performance of which *Hystiæus* took occasion to Imprint his secret Intentions on his Servant's Head; and keeping him close at Home till his Hair was grown, he then told him, That for his perfect Recovery, he must travel into *Greece* unto *Aristagoras*, who by shaving his Hair the second Time, would certainly restore him. By which Relation you may see what strange Shifts the Ancients were put unto, for want of Skill in this Subject that is here discoursed of.

Herod. l. 5. c. 35.
Noctes Atti. l. 17. c. 10.

'Tis reported of some Fugitive *Jews* at the Siege of *Jerusalem*, who more securely to carry away their Gold, did first melt it into Bullets, and then swallow it down, venting it afterwards amongst their other

Joseph. de Bello Juda. l. 6. c. 15.

Excre-

Excrements. Now if a Man had but his Faculty, who could write *Homer*'s *Iliads* in so small a Volume as might be contained in a Nut-shell; it were an easie Matter for him, by this Trick of the *Jews*, securely to convey a whole Pacquet of Letters. *Solin. Polyhist. c. 6.*

2. When all the Land-Passages have been stopped up, then have the Ancients used other secret Conveyances by Water; writing their Intentions on thin Plates of Lead, and fastning them to the Arms or Thighs of some expert Swimmer. * *Frontinus* relates, that when *Lucullus* would inform a Besieged City of his coming to succour them, he put his Letters into two Bladders, betwixt which a common Soldier in the Disguise of a Sea-monster, was appointed to swim into the City. There have been likewise more exquisite Inventions to pass under the Water, either by a Man's Self, or in a Boat, wherein he might also carry Provision, only having a long Trunk or Pipe, with a Tunnel at the Top of it, to let down fresh Air. But for the Prevention of all such Conveyances, the Ancients were wont in their strictest Sieges, to cross the Rivers with strong * Nets, to fasten Stakes in several Parts of the Channel with sharp Irons, as the Blades of Swords, sticking upon them. 2. By Water. * *De Stratag. l. 3. c. 13.* * *Plin. l. 10. c. 37.*

3. Hence was it that there have been other means attempted through the open Air, either by using Birds, as Pigeons and Swallows instead of Messengers, of which I shall treat more particularly in the sixteenth Chapter. Or else by fastning a Writing to an Arrow, or the Weight that is cast from a Sling. 3. Thro' the open Air.

Somewhat of this Nature, was that Intimation agreed upon betwixt *David* and *Jonathan*, though that Invention does somewhat savour of the Ancient Simplicity and Rudeness. It was a more exact Invention mentioned by *Herodotus* concerning *Artabazus* and *Timoxenus*, who when they could not come together, were wont to inform one another of any 1 Sam. 20. *Urania sive l. 8. c. 128.*

Thing

Thing that concerned their Affairs, by fastning a Letter unto an Arrow, and directing it unto some appointed Place, where it might be received.

Polyænus, l. 2. See Plutarch in Cimon.

Thus also *Cleonymus* King of *Lacedæmon*, in the Siege of the City *Trezene*, enjoyned the Soldiers to shoot several Arrows into the Town, with Notes fastned unto them having this Inscription, Ἥκω ἵν' πολιν ἐλευθερώσων. *I come that I may restore this Place to its Liberty.* Upon which the credulous and discontented Inhabitants were very willing to let him enter.

When *Cicero* was so streightly Besieged by the *Gauls*, that the Soldiers were almost ready to yield; *Cæsar* being desirous to encourage him with the News of some other Forces that were to come unto his Aid, did shoot an Arrow into the City, with these Words fastned unto it, *Cæsar Ciceroni fiduciam optat, expecta auxiliam.* By which means the Soldiers were persuaded to hold out so long, till these new Succours did arrive and break up the Siege.

The same thing might also be done more securely, by rolling up a Note within the Head of an Arrow, and then Shooting of it to a Confederates Tent, or to any other appointed Place.

Poliorcet. l. 4. c. Dialog. 2. mentioned also by *Heliodor. Hist. Æthio. l. 9.*

To this purpose is that which *Lypsius* relates out of *Appian*, concerning an ancient Custom for the Besieged to write their Minds briefly in a little Piece of Lead, which they could with a Sling cast a great Distance, and exactly hit any such particular Place as should be agreed upon, where the Confederate might receive it, and by the same means return an Answer.

Of this Nature likewise are those kind of Bullets, lately invented in these *German* Wars, in which they can shoot, not only Letters, Corn, and the like, but (which is the strangest) Powder also into a besieged City.

But

But amongst all other possible Conveyances thro' the Air, Imagination it self cannot conceive any one more useful, than the Invention of a flying Chariot, which I have mentioned elsewhere. Since by this means a Man may have as free a Passage as a Bird, which is not hindered, either by the highest Walls, or the deepest Rivers and Trenches, or the most watchful Centinels. But of this perhaps I may have occasion to treat more largely in some other Discourse.

World in the Moon, chap. 14.

CHAP. V.

Of that Secresy which consists in the Materials *of Writing, whether the Paper or Ink.*

THE several Inventions of the Ancients, for the private *Conveyance* of any written Message, were the Subject of the last Chapter.

The Secresy of *Writing* may consist,

Either in { The Materials, Or, The Form.

1. The *Materials* of Writing, are, the Paper and Ink, (or that which is instead of them) both which may be so privately ordered, that the inscribed Sense shall not be discoverable, without certain Helps and Directions.

Selenus de Cryptogra. l. 8. c. 1. 4.

1. The chief Contrivance of Secresy by the Paper in Us amongst the Ancients, was, the *Lacedemonian Scytale*; the Manner of which was thus: There were provided two round Staves, of an equal Length and Size, the Magistrates always retaining one of them at Home, and the other being carry'd abroad by the General, at his going forth to War. When there was any secret Business to be writ by it, their manner was, to wrap a narrow Thong of Parchment about one of these Staves,

1. The Paper.

by

by a Serpentine Revolution, so that the Edges of it might meet close together; upon both which Edges they inscribed their Epistle; whereas, the Parchment being taken off, there appear'd nothing but Pieces of Letters on the Sides of it, which could not be joined together into the right Sense, without the true *Scytale*. Thus is it briefly and fully described by *Ausonius*.

Ausonius ad Paulinum.

Vel Lacedemoniam Scytalen imitare libelli,
Segmina Pergamei, tereti, circumdata ligno,
Perpetuo inscribens versu, deinde solutus,
Non respondentes sparso dabit ordine formas.

In Vita Lysandri. You may read in *Plutarch*, how by this means *Pharnabaz* did deceive *Lysander*.

Exerc. 327. 'Tis true, indeed, that this Way was not of such inextricable Secresy, but that a little Examination might have easily discover'd it, (as *Scaliger* truly observes); however, in those Ages, which were less versed in these Kinds of Experiments, it seemed much more secret than now it does unto us; and in these Times, there are such other means of private Discoursing, which even *Scaliger*'s Eyes (as good as they were) could not discover. And therefore it was too inconsiderate and magisterial a Sentence of

Vossius de Arte Gram. l. 1. *c.* 40. him, from thence to conclude all this kind of Learning to be vain and useless, serving only for Imposture, and to perplex the Enquirer.

'Tis certain, that some Occasions may require the exactest Privacy; and 'tis as certain, that there may be some Ways of Secresy, which it were Madness for a Man to think he could unfold. *Furori simile*

Veget. de re milit. l. 3. *esse videtur, sibi aliquem persuadere, tam circumspectum hominem esse posse, ut se à furtivo quodam scripto, abditaq; machinatione tueri possit: Nam astans quilibet, vel procul distans loquitur, & factum nunciat, ut non solum à nemine percipiatur, sed ne sic quidem significare quippiam posse existimet*, saith *Vegetius*. And *Baptista Porta*,

Proœm. l. 3. *de furtivis notis.* who had a strange and incredible Ability in discovering

vering of Secret Writings, yet doth ingeniously confeſs, *Multa eſſe poſſe furtiva ſcripta, quæ ſe interpretaturum quenquam polliceri, furorem ac delirium plane exiſtimarem.*

So that tho' the Ancient Inventions of this Kind were too eaſily diſcoverable, yet *Scaliger* had no Reaſon to conclude this to be a needleſs Art, or that therefore he could unfold any other way that might be invented. But this by the by.

2. The other Material of Writing, is, the Ink, or that Liquor which is uſed inſtead of it; by which Means alſo there are ſundry Ways of Secreſy, commonly mentioned in Natural *Magick.* 2. The Ink.

Thus, if a Man write with Salt *Armoniack* diſſolved in Water, the Letters will not appear legible, till the Paper be held by the Fire: This others affirm to be true alſo in the Juice of Onions, Lemons, with divers the like Acid and Corroding Moiſtures. *Porta Magiæ, l. 16. Wecker. de Secret. l. 14. Joach. Fortius Experient. Cardan. Subt. l. 17.*

And on the contrary, thoſe Letters that are written with diſſolved Allum, will not be diſcernable, till the Paper be dipped in Water. *Item de varietate, l. 12. c. 61.*

There are ſome other Juices, that do not appear, till the Paper be held betwixt a Candle and the Eye. *Ibid.*

That which is written with the Water of putrify'd Willow, or the diſtilled Juice of Gloworms, will not be viſible but in the Dark; as *Porta* affirms from his own Experience. *Bibliander de Ratione com. linguarum. De furtiv. lit. l. 1. c. 15.*

There is alſo a Secret Way of Writing with two ſeveral Inks, both of them alike in Colour, but the one being of that Nature, that it will eaſily be rubbed or waſhed off, and the other not.

A Man may likewiſe write ſecretly with a raw Egg, the Letters of which being throughly dried, let the whole Paper be blacked over with Ink, that it may appear without any Inſcription; and when this Ink is alſo well dried, if you do afterwards gently ſcrape it over with a Knife, it will fall off

from

from those Places, where before the Words were written.

Those Letters that were described with Milk, or Urine, or Fat, or any other glutinous Moisture, will not be legible, unless Dust be first scatter'd upon them; which, by adhering to those Places, will discover the Writing. This Way is mentioned by *Ovid*:

De Arte Amandi.

Tuta quoq; est, fallitq; oculos è lacte recenti
Litera, carbonis pulvere tange, leges.

And 'tis thought that *Attalus* made use of this Device, the better to excite the Courage of his Soldiers. Being before the Battel to sacrifice to the gods for Success, as he pulled out the Entrails of the Beast, he described upon them these words, *Regis Victoria*, which he had before written backward in his hand with some gummy Juice. The Entrails being turned up and down by the Priest, to find out their signification, the Letters did by that means gather so much Dust as to appear legible. By which *Omen* the Soldiers were so strangely heighten'd in their Hopes and Valour, that they won the Day.

Gust. Selenus de Cryptographia, l. 8. c. 3.

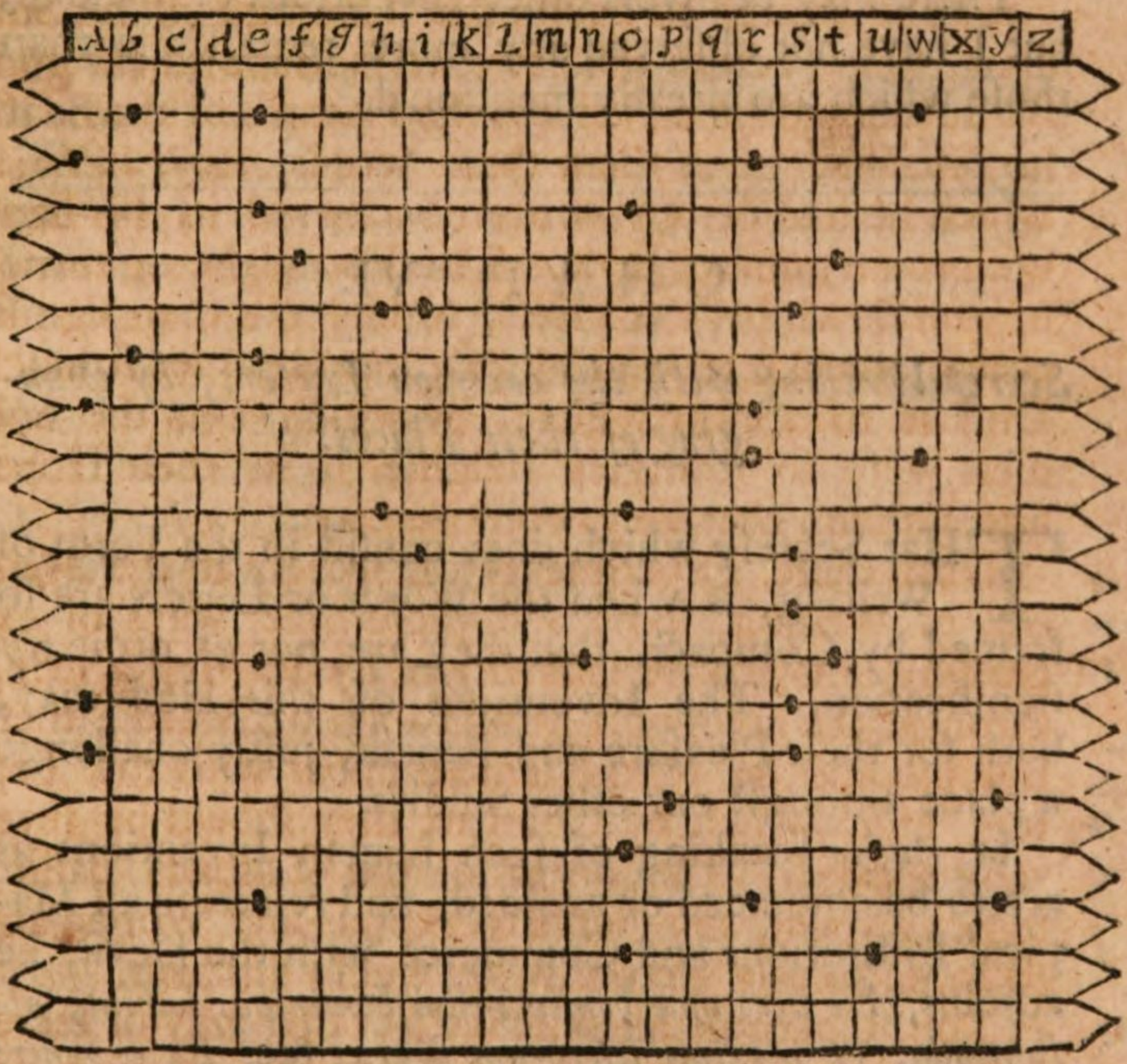
Unto these Experiments of Secresy in the *Materials* of Writing, some add those other ways of expressing any private Intimation, by drawing a String through the holes of a little Tablet or Board; these holes should be of the same number with the Letters, unto which by Compact they should be severally applied. The order of the Threads passing through them, may serve to express any Words, and so consequently any Sense we would discover.

To this purpose likewise is that other way of secret Information, by divers Knots tied upon a String, according to certain Distances, by which a Man may as distinctly, and yet as *Secretly*, express his Meaning, as by any other way of Discourse. For who would mistrust any private News or Treachery to lye hid in a Thread, wherein there was nothing to

be

be discerned, but sundry confused Knots, or other the like Marks ?

The Manner of performing it is thus: Let there be a square piece of Plate, or Tablet of Wood like a Trencher, with the Twenty four Letters described on the top of it, at equal distances, and after any order that may be agreed upon before-hand; on both the opposite sides let there be divers little Teeth, on which the String may be hitched or fasten'd for its several Returns, as in the following Figure.



Where the String is supposed to be fasten'd by a Loop on the first Tooth, towards the Letter A, and afterwards to be drawn successively over all the rest. The Marks upon it do express the secret Meaning: *Beware of this Bearer, who is sent as a Spy over you.*

When it is taken off, and sent to a Confederate, he may easily understand its intention, by applying it to his own Tablet, which must be answerable unto this. The Instrument may be made much longer than is here expressed: But if the Matter to be revealed should happen to be more than the Tablet would bear, then may it be supplied either by another String, or else by beginning again with that part of the same String wherein the last Letter was terminated.

There may be divers other Inventions of this kind, but I have not observed any more remarkable than those which are already mention'd.

CHAP. VI.

Secret Writing with the common Letters, by changing of their Places.

Selenus de Cryptographia, l. 2. c. 5. *Ars [illegible]arum occultandi inter artes Subtilitate præstantes annumeranda est.* Cardan. Subtil. l. 17. De Doctrin. Christiana, l. 2. c. 26.

THat Secresy which does consist in the Form of Writing, is when the Words or Letters are so framed by Compact, that they are not of ordinary signification. The Inventions of this kind may, both for their Pleasure and Benefit, justly challenge a place amongst our other Studies.

St. *Austin* speaking of such human Inventions as are to be embraced or avoided, and rejecting all Magical Institutions and Commerce with the Devil, he adjoins, *Ea verò quæ homines cum hominibus habent, assumenda, & maxime literarum figuræ*, &c. *Ex eo genere sunt etiam notæ, quas qui didicerunt, proprie notarii appellantur. Utilia sunt ista, nec discuntur illicite, nec superstitiose implicant, nec luxu enervant, si tantum occupent, ut majoribus rebus, quibus inservire debent, non sint impedimento.*

This

This way of Secret Writing may be contrived, either,

1. By the common Letters.
2. Or by some invented Notes and Characters instead of them.

Both these being distinguishable into those kinds that contain either,

1. Equal.
2. Or more.
3. Or fewer Signs than are naturally required to the true framing of the Word.

The particulars of these may be altered to such great Variety as cannot be reckoned, and therefore I shall specify those only which seem most remarkable, either for their Antiquity or Usefulness.

The Way of Secret Writing by equal Letters, is, either by Changing of

1. Their Places, or
2. Their Powers.

1. By altering of the Places;

Either of the { Lines. / Letters. / Both.

1. A Man may obscure the Sense, by perplexing the Order of the *Lines*. If they be written, not only from the Left Hand to the Right, but also from the Right Hand to the Left, as in the *Eastern* Languages; or from the Top to the Bottom, and so upward again, as is commonly related to be usual amongst the Inhabitants of *Taprobana* in the *South* Sea, with those in *China* and *Japan*: According to this following Example.

1. By transposing the Lines.

Diodor. Sic. Biblioth. l. 2. Herman. Hugo de Orig. Scrib. c. 8.

e r f d l e e l l t
i e t o o ſ w i i h
l ſ u u h h s n t e
p h o t o a v c s p
p a h t t l t r h e
u n t h e l s e t s
ſ d i e l n g a o t
y ſ w ſ b o n ſ d i
d p e i a t o e c l
e e g e e b m a n e

In the Reading of which, if you begin at the firſt Letter towards the Right Hand, and ſo downwards, and then upwards again, you may find theſe Words expreſſed:

The Peſtilence doth ſtill increaſe amongſt us; we ſhall not be able to hold out the Siege, without freſh and ſpeedy Supply.

2. By tranſpoſing the Letters.

2. A Man may obſcure the Senſe of his Writing, by tranſpoſing each *Letter*, according to ſome unuſual Order. As, ſuppoſe the firſt Letter ſhould be at the latter End of the Line, the ſecond at the Beginning, or the like.

3. By tranſpoſing both the Lines and Letters.

3. The Meaning of any written Meſſage may be concealed, by altering the Order both of the *Letters* and the *Lines* together. As if a Man ſhould write each Letter in two ſeveral Lines, thus:

T e o l i r a e l m s f m ſ e s p l v o w e u t e l
h ſ u d e ſ r a l o t a i h d, u p y s r e m s y i d

The Souldiers are almoſt famiſhed; Supply us, or we muſt yield.

* Or as many more as the length of the Epiſtle ſhall require.

This way may be yet further obſcured, by placing them in * four Lines, and after any diſcontinuate Order. As, ſuppoſe that the firſt Letter be in the Begin-

Beginning of the first Line, the second in the Beginning of the fourth Line, the third in the End of the first, the fourth in the End of the fourth, the fifth in the Beginning of the second Line, the sixth in the Beginning of the third, the seventh in the End of the second, the eighth in the End of the third; and so of the rest: As in this Example.

W m r p i t a h h s c t e i n p k e
h a t h f o n o i h k f t o e n i l
a n o e r r o c g t t t h m n v r l
e a u o m h t e i n l e n e t t e f

Which in its Resolution is this:

We shall make an Irruption upon the Enemy from the North, *at Ten of the Clock this Night.*

This way will yet seem more obscure, if each Line be sever'd into such Words as may seem barbarous. *Walchius, Fab. 9.*

All these Kinds may be varied unto divers other more intricate Transpositions, according as a Man's Fancy or Occasion shall lead him.

CHAP. VII.

Concerning Secret Writing with equal Letters, by changing their Powers. *The Use of this amongst the* Jews *and* Romans. *The Key-Character.*

AS a written Message may be concealed by changing the Places of the Letters, so likewise by changing of their *Powers*, putting one of them for another, as suppose L for A, and A for L, or the like: Answerable to that Kind of Cabalism in the *Jewish* Learning, which the Rabies call צירוף, *Schickard in Bechinath. Haperus. Disp. l. 4 Glassius Philolog. l. 2. pars tract 1.*

or *Combinatio*; when the Letters of the Alphabet are severally transposed, and taken one for another, after any known Order. Of which there be as many Kinds, as there may be several Combinations of the Letters: But amongst the rest, they observe two of more frequent Use. The first is stiled from the four first Correspondent Letters אלבם *Albam*; in which they are thus opposite to one another.

א ב ג ד ה ו ז ח ט י כ
ל מ נ ס ע פ צ ק ר ש ת

The other is from the same Reason called אתבש *Athbash*, wherein the Letters are thus mutually opposed:

א ב ג ד ה ו ז ח ט י כ
ת ש ר ק צ פ ע ס נ מ ל

Both these Kinds of Secret Writing, the *Jewish* Doctors think to be frequently used by the Sacred Penmen of Holy Writ; amongst whom, the Prophet *Isaiah* and *Jeremiah* are observed to be of more especial Note for their Skill in Cabalisms.

By the first of these Combinations, called *Albam*, that Place of *Isaiah* 7. 6. is usually interpreted; where there is a Person mentioned, under the unknown Name of טבאל *Tabeal*, whom the Prophet affirms to aspire unto the Crown of *Judah*; meaning, by a secret Transmutation of the Letters, רמלה *Remaliah* the King of *Israel*, whom he was loth more expressly to nominate: And therefore he veils it by this kind of Secresy, instead of ר writing the Letter above it ט; for מ, the Correspondent Letter ב; and so ל for א, and א for ל. Which being joined together, do make טבאל, instead of רמלא.

By

By the second of these Combinations, called *Athbash*, is that Place, *Jerem.* 51. 1. translated; where by the Original לב קמי *Cor insurgentium contra me*, is meant כשדים the *Chaldæans*; and therefore both the *Targum*, and the *Septuagint* do unanimously translate it so; as if in their Version of it, they had chiefly respect unto this kind of Cabalism. So likewise in 41 Verse of the same Chapter, by the feigned Name of ששך, is meant בבל. *Item c. 25. v. 26. fide Hieron. com. in eundem locum.*

This way of Secret Writing hath been also in use amongst the Ancient *Romans*: Thus *Suetonius* relates of *Julius Cæsar*, when he would convey any private Business, he did usually write it, *per quartam Elementorum Literam*; that is, D for A, E for B, and so of the rest, after this Order. *Sueton. in vita ejus. A. Gellius Noct. Attic. l. 17. c. 9.*

d e f g h i k l m n o p q r s t u w x y z a b c
a b c d e f g h i k l m n o p q r s t u w x y z.

Hasten unto me.
Ldwxhq yqxr ph.

And the same Author reports of *Octavius Augustus*, that in the writing of his Secrets, he did *secundum Elementum proprii loco substituere*, set down the second Letter for the first, as B for A, C for B, and for A a Double x x.

But now, because such an Epistle might be easily unfolded, being altogether written by the same way; therefore this kind of Secresy hath, by later Invention, been further obscured, by writing each several Word, or Line, or Letter, by a diverse Alphabet.

For the Performance of this, two Friends must before-hand, by Compact, agree upon some certain Form of Words, that may be instead of a Key, serving both to close, and to unlock the Writing;

which Words would be leſs diſcoverable, if they be barbarous, and of no Signification.

But for the eaſier apprehending of this, I ſhall explain it in an Example.

Suppoſe the Key agreed upon, were only this one Word *Prudentia.*

Having firſt framed ſeveral Alphabets, according to each of its Letters, thus:

A	b	c	d	e	f	g	h	i	k	l	m	n	o	p	q	r	s	t	u	w	x	y	z
P	q	r	ſ	t	v	w	x	y	z	a	b	c	d	e	f	g	h	i	k	l	m	n	o
R	s	t	u	w	x	y	z	a	b	c	d	e	f	g	h	i	k	l	m	n	o	p	q
U	w	x	y	z	a	b	c	d	e	f	g	h	i	k	l	m	n	o	p	q	r	s	t
D	e	f	g	h	i	k	l	m	n	o	p	q	r	s	t	u	w	x	y	z	a	b	c
E	f	g	h	i	k	l	m	n	o	p	q	r	s	t	u	w	x	y	z	a	b	c	d
N	o	p	q	r	s	t	u	w	x	y	z	a	b	c	d	e	f	g	h	i	k	l	m
T	u	w	x	y	z	a	b	c	d	e	f	g	h	i	k	l	m	n	o	p	q	r	s
I	k	l	m	n	o	p	q	r	s	t	u	w	x	y	z	a	b	c	d	e	f	g	h
A	b	c	d	e	f	g	h	i	k	l	m	n	o	p	q	r	s	t	u	w	x	y	z

I may write each Line, or Word, or Letter, according as the Order of theſe Alphabets ſhall direct. As in theſe,

1. In the Lines.

Ixt hdkasytgh bkiycn
xfi nrel fx matlmrck;
npkkfs pn, im oczs qdff
uhyrox xr xlh hqmpmh.

2. In the Words.

Ixt kfmcuawik gpodhs
iru aery bs oiwnotem;
bdyytg vs, dg lzwp qdff
uhyrox ys gur ygcfcy.

3. In

3. In the Letters.

Izz wshemitin in pzgcwy
vfm zean xf kaxxznebr
skgkoc hm, xr izzb awet
rtm iox gh cht whmqwy.

Which Examples being unfolded, do each of them expreſs this inward Meaning:

The Souldiers mutiny
for want of Victuals;
Supply us, or they will
Revolt to the Enemy.

Theſe Ways may be yet further obſcured, if the firſt Alphabet, (according to which the reſt are deſcribed) be contrived after any mixed Order. As, ſuppoſe inſtead of the ordinary A b c, *&c.* there be written theſe Letters, after this manner.

R z k m p s e b l a u f t c y g w h x o q i n d.

And then will they be liable to all thoſe other Differences of Secreſy, that are uſually invented by the *Wheel Character*, which you may ſee largely deſcribed by *Porta.*

There may be divers other Ways to this purpoſe, but by theſe you may ſufficiently diſcern the Nature of the reſt.

CHAP. V.

Of Secret Writing by more Letters than are requiſite to the intended meaning.

THE different kinds of Secreſy by *equal Letters* have been already handled. The next particular

cular to be discussed, is concerning the Ways of hiding any private Sense under *more Letters* than are required to the Words of it.

Of which kind there may be divers particulars, some of them in Use amongst the Ancients.

1. A Writing may be so contrived, that only one Letter in a Verse shall be significant. As it was in those remarkable *Acrosticks* made by a *Sybil* concerning our Saviour; where the Letters at the Beginning of each Verse, being put together, made up these Words, Ἰησοῦς Χριστὸς Θεοῦ υἱὸς σωτήρ. *Jesus Christ the Son of God, a Saviour.*

Sybilla Erythræa.

The Translation of these you may see in St. *Augustin de Civit. Dei, lib.* 18. *cap.* 23. And the Original are mentioned by *Ludovicus Vives*, in his Notes upon that Place.

Beda l. de Sybillis.

According unto this doth *Plautus* contrive the Names of his Comedies in the first Letters of their Arguments. But this Way is so ordinary in Practice, that it needs not any further Explication.

2. The inward Sense hath likewise been conveyed by some single Letters of several Words in the same Verse. As in that common Distich.

Vale.

Mitto tibi caput Veneris, ventremque Dianæ
Latroniſque caput, posteriora canE.

3. Sometimes one Letter in each Word was only significant. By which Way of Secret Expression, the Holy Ghost (say the *Rabbies*) hath purposely involved many sacred Mysteries in Scripture. When these significant Letters were at the Beginning of each Word, the *Cabalists* in their Learning, called such an implicit Writing ראשי תיבות *Capita Dictionum.* When they were at the latter End, then was it stiled סופי תיבות *Fines dictionum.* Both being reckoned as Species of that *Cabalism* which they called נוטריקון *Notaricon*, imposed by some later *Rabbies* from the *Latin* Word *Notarius.*

Of the first Sort, is that Collection from those eminent Words, *Gen.* 49. 10. יָבֹא שִׁילֹה וְלוֹ *Shilo shall come, and in him*, &c. where the Capital Letters make up the Word ישו *Jesu*. The Capital Letters.

So Psal. 72. 17. יִנּוֹן שְׁמוֹ וְיִתְבָּרְכוּ בוֹ *His name shall continue, and in him shall be blessed*, &c. which Place does expresly treat concerning the *Messias* his Name, and therefore seems unto the *Jews*, to be of strong Consequence for the Proof of Christianity. For so much is that Nation befooled in their absurd Dotage upon these trivial literal Collections, that a Reason of this Nature is of greater force unto them, than the most evident solid Demonstration that may be urged. *Ludovicus Carret*, a famous *Jew*, Physician to the *French* King, being himself converted, and writing an Epistle to this Purpose, unto those of his own Nation, he does chiefly insist upon the Arguments of this kind, as being in his Opinion of greatest Efficacy to prove the Truth of Christian Religion. *Lib. Visorum Divinorum.*

Of the other Sort is that Passage, *Gen.* 1. 1. בְּרֵאשִׁית בָּרָא אֱלֹהִים אֵת where the final Letters make up the Word אמת or *Truth*. Which kind of *Cabalism* is six Times repeated in the History of the Creation. As if *Moses* by such an artificial Contrivance of the Letters at the Beginning of his Writings, did purposely commend unto our Belief his following Books. Unto this *David* is thought to allude, *Psal.* 119. 160. *The beginning of thy word is* אמת *Truth*. Of this Nature likewise is that Observation from *Exod.* 3. 13. לִי מָה שְׁמוֹ מָה. *When they shall say unto me, what is his name*, &c. Where the final Letters answer יהוה *Jehovah*. The final Letters.

It were an easie matter for a Man that had Leisure and Patience for such Enquiries, to find out sundry Arguments of this kind for any Purpose.

4. There is another way of hiding any secret Sense under an ordinary Epistle, by having a * Plate with certain Holes in it, through which (being *Cardande subtil. l. 17. Porta de furt. l. 2. c. 18.

Such as Printers use when they are to insert diverse red Letters amongst the black.

ing laid upon the Paper) a Man may write those Letters or Words, that serve to express the inward Sense; the other Spaces being afterwards filled up with such other Words, as in their Conjunction to these former, shall contain some common unsuspected Business.

5. There is also another intricate Way to this Purpose, much insisted on by *Trithemius*, *Porta*, and *Sylenus*. When each usual Word or Form of an Epistle, is varied to as many Differences as there are Letters, unto which they must all of them be severally assigned. But these two latter Inventions (tho' they be of great Secresy, yet) because they require so much Labour and Trouble in the Writer, I shall therefore pass them over without any further Enlargement.

CHAP. IX.

Of concealing any written Sense under Barbarous Words, and such as shall not seem to be of any Signification. How all the Letters may be expressed by any Five, Three, or Two of them. Of Writing with a double Alphabet. How from these two last Ways together, there may be contrived the best kind of Secret Writing.

ALL the Ways of Secresy by *more Letters*, already specified, do make the Writing appear under some other Sense, than what is intended, and so consequently are more free from Suspicion: There are likewise some other Inventions to express any inward Sense by barbarous Words, wherein only the first, and middle, and last Letters shall be significant. As in this Example.

Fildy,

Fildy, fagodur wyndeeldrare discogure rantibrad.
Which in its resolution is no more than this:

Fly for we are discovered.

To this Purpose likewise is that other Way of expressing the whole Alphabet by any five, or three, or two of the Letters repeated. And though such a Writing, to ordinary Appearance, will seem of no Signification at all, and so may seem of less Use; yet because a right Apprehension of these Ways may conduce to the Explication of some other particulars that follow, it will not be amiss therefore to set them down more distinctly.

All the Letters may be expressed by any five of them doubled. Suppose A B C D E.

A B C D E F G H I K L M N
aa ab ac ad ae ba bb bc bd be ca cb cc

O P Q R S T V W X Y Z. &
cd ce da db dc dd de ea eb ec ed ee

According to which, these Words, *I am betrayed*, may be thus described.

Bd aacb abaedddbaaecaead.

Three Letters being transposed through three Places, do give sufficient Difference, whereby to express the whole Alphabet.

A B C D E F G H I
aaa aab aac baa bba bbb bbc caa cca

K L M N O P Q R S
ccb ccc aba abb abc aca acb acc bca

T V W X Y Z &.
bcb bcc bab cba cbb cbc bac

Hasten unto me.

Caa aaa bca bcb bba abb bcc abb bcb abc aba bba.

The whole Alphabet expressed by any 2 Letters in five Places.

Two Letters of the Alphabet being transposed through five Places, will yield thirty two Differences, and so will more than serve for the Four and twenty Letters; unto which they may be thus applied.

A. *B.* *C.* *D.* *E.* *F.* *G.*
aaaaa. *aaaab.* *aaaba.* *aaabb.* *aabaa.* *aabab.* *aabba.*

H. *I* *K.* *L.* *M.* *N.* *O.*
aabbb. *abaaa.* *abaab.* *ababa.* *abaab.* *abbaa.* *abbab.*

P. *Q.* *R.* *S.* *T.* *V.* *W.*
abbba. *abbbb.* *baaaa.* *baaab.* *baaba.* *baabb.* *babaa.*

X. *Y.* *Z.*
babab. *babba.* *babbb.*

aababababababba aaaaababaaaaaaaababba.

f l y a w a y.

Writing by a double Alphabet.

There is yet another Way of Secresy by more Letters than are naturally required to the inward Sense; if we write with a double Alphabet, wherein each Letter shall in the Fashion of it, bear some such small Distinction from the other of the same kind, as is usual in common mixed Writing. *For Example.*

The first Alphabet.

Aa. Bb. Cc. Dd. Ee. Ff. Gg. Hh
Ii. Kk. Ll. Mm. Nn. Oo. Pp. Qq.
Rr. Ss. Tt. Vuv. Ww. Xy. Yy. Zz.

the ſecond Alphabet.

ſa. Bb. Cc. Dd. Ee. ff. Gg. Hh
Ii. Kk. Ll. Mm. Nn. Oo. Pp. Qq.
Rr. Sſs. Tt. Vuv. Ww. Xx. Yy. Zz.

1. Write an Epiſtle of an ordinary Matter, or (if it be needful) contrary to what you intend. Let the Body of it conſiſt chiefly of the firſt Alphabet, only inſerting (as you have occaſion) ſuch Letters of the ſecond, as may expreſs that inward meaning which you would reveal to a Confederate.

For Example, from thoſe that are Beſieged.

Wee prosper stillin our af-
faires. and ſhall (without
having any further helpe)
endure the ſiege.

In

In which Clauſe, the Letters of the ſecond Alphabet are only ſignificant, expreſſing this inward Senſe.

Weeperiſh with hunger
helpe us.

But becauſe the Differences betwixt theſe two Alphabets may ſeem more eaſily diſcoverable, ſince they are both generally of the ſame kind, the Letters of the ſecond being all of them more round and full than the other; therefore for their better Secreſy in this particular, it were ſafer to mix them both by Compact, that they might not in themſelves be diſtinguiſhable.

The beſt way of ſecret writing. *Bacon. Augment. ſcient. l. 6. c. 8.*

Now if this kind of Writing be mixed with the latter Way of Secreſy, by two Letters tranſpoſed through five Places, we may then write *omnia per omnia*, which (as a learned Man ſpeaks) is the higheſt Degree of this Cyphering.

For ſuppoſing each Letter of the firſt Alphabet to be inſtead of the Letter A, and thoſe of the other for B, we may eaſily inſcribe any ſecret Senſe in any ordinary Letter, only by a quintuple Proportion of the Writing infolding to the Writing infolded. As for Example.

All

All things do happen according to our desires, the particulars you shall vnderstand when wee meete at the appointed time and place of which you must not faile by any meanes The Successe of our affairs dos much depend vpon the meeting that wee have agreed vpon.

The involved meaning of which Clause is this:
Fly, for we are discovered, I am forced to write this.
If you suppose each Letter of the first Alphabet to be instead of A, and those of the second for B, then will the former Clause be equivalent to this following Description.

Aabab ababa babba aabab abbab baaaa babaa
F l y f o r w

aabaa aabaa aaaaa baaaa aabaa aaabb abaaa
e e a r e d i

baaab aaaba abbab baabb aabaa baaaa aabaa
ſ c o v e r e

aaabb abaaa aaaaa ababb aabab abbab baaaa
d, I a m f o r

aaaba aabaa aaabb baaba abbab babaa baaaa
c e d t o w r

abaaa baaba aabaa baaba aabbb abaaa baaab.
i t e t h i s.

This Way of Secreſy may be ſerviceable for ſuch Occaſions as theſe. Suppoſe a Man were taken Captive, he may by this means diſcover to his Friends the Secrets of the Enemies Camp, under the outward Form of a Letter perſuading them to yield. Or, ſuppoſe ſuch a Man were forced by his own Hand-writing to betray his Cauſe and Party, though the Words of it in common Appearance may expreſs what the Enemy does deſire; yet the involved meaning, (which ſhall be legible only to his Confederates) may contain any thing elſe which he has a Mind to diſcover to them: As in the former Example.

But now if there be a threefold Alphabet, (as is eaſie to contrive) then the inward Writing will bear unto the outward but a triple Proportion, which will be much more convenient for enlarging of the private Intimations.

And this Way of Writing is juſtly to be preferred before any of the other, as containing in it more eminently, all thoſe Conditions that are deſirable in ſuch kind of Inventions. As, 1. 'Tis

1. 'Tis not very laborious either to write or read.
2. 'Tis very difficult to be decyphered by the Enemy.
3. 'Tis void of Suspicion.

But by the way, 'tis to be generally observed, that the mixture of divers kinds of secret Writing together (as suppose this with the Key-character) will make the inward Sense to be much more intricate and perplexed.

CHAP. X.

Of Writing any Secret Sense by fewer Letters than are required to the Words of it. The Use of this amongst the Jews *and* Romans.

AS the Sense may be obscured by writing it with more Letters than are required to the Words of it, so likewise by fewer. Abbreviations have been anciently used in all the Learned Languages, especially in common Forms, and Phrases of frequent Use. Sometimes by contracting Words, when some Parts of them did stand for the whole. So in the *Hebrew*, וכו' for וכולו *et totum illud*, which is all one with our *et cetera*, &c. כלו' for כלומר *Secundum dicere*, equivalent to our *viz.* or *v. g. verbi gratia*. So likewise in the *Greek*, Χ̄ς for Χριστὸς, and ἀν̄ῳ for ἀνθρωπὸς. And in the *Latin*, *Dn̄s* for *Dominus*; *aa* for *Animа*, and the like. But these were rather for the speed of Writing, than the Secresy. *Buxtorf. de Abbreviat. in initio.*

Sometimes Words were expressed only by their first Letters. Thus did the *Jews* write all their Memorials, and common Forms, which are largely handled by *Buxtorf.* Hence was it, that their Captain *Judas* had his Name of *Maccaby*; for being to fight a- *Ibid.*

gainſt *Antiochus*, he gave that ſaying for his Watch-word, *Exod.* 15. מי כמכה באלהים יהוה. *Who is like unto thee (O Lord) amongſt the Gods?* inſcribing in his Enſigns the Capital Letters of it, מכבי *Maccabi.* Whereupon after the Victory, the Soldiers ſtiled their Captain by that Name.

'Tis obſerved by the *Rabbies*, that many grand Myſteries are this Way implied in the Words of Scripture. Thus, where it is ſaid, *Pſal.* 3. רבים *Many riſe up againſt me*, 'tis interpreted from the ſeveral Letters, *Reſh* the *Romans*, *Beth* the *Babylonians*, *Jod* the *Jonians* or *Grecians*, *Mem* the *Medes*. Anſwerable unto which, that Place in *Gen.* 49. 10. (ſpeaking of *Shilo*, unto whom יקהת the *gathering* of the People ſhall be) is by another *Rabby* applied to the *Jews*, *Chriſtians*, *Heathens*, and *Turks*.

Upon theſe Grounds likewiſe, is that Argument to prove the Trinity, from the firſt Verſe of *Geneſis*. ברא אלהים The Word אלהים *Elohim*, being of the Plural Number, is thought to be that Divine Name which denoteth the Perſons of the Deity; which Perſons are more particularly intimated in the Letters of the Verb ברא, that anſwers unto it: ב *Beth* being put for בן the Son, ר *Reſh* for רוח the Holy Ghoſt, א *Aleph* for אב the Father. And if you will believe the *Jews*, the Holy Spirit hath purpoſely involved in the Words of Scripture, every Secret that belongs to any Art or Science, under ſuch Cabaliſms as theſe. And if a Man were but expert in unfolding of them, it were eaſie for him to get as much Knowledge as *Adam* had in his Innocency, or Human Nature is capable of.

Theſe kind of myſterious Interpretations from particular Letters, do ſeem to be ſomewhat favoured, by God's Addition of the Letter ה unto the Name of *Abram* and *Sara*, upon the renewing of his Covenant with them; which in all likelihood was not without ſome ſecret Myſtery. That being the chief Letter

Gen. 17. 5. 15.

of

of the *Tetragammaton*, might perhaps intimate that amongst their other Posterity, with the Promise of which he had then Blessed them, they should also be the Parents of the *Messias*, who was *Jehovah.*

This likewise others have confirmed from the Example of Christ, who calls himself *Alpha* and *Omega*, Rev. 1. 8. *Vide Tertul. l. de præscr. c. 50.*

But though such Conjectures may be allowable in some particulars, yet to make all Scriptures capable of the like Secrets, does give such a Latitude to Men's roving and corrupt Fancies, as must needs occasion many wild and strange Absurdities. And therefore *Irenæus* does fitly observe, that from such idle Collections as these, many Heresies of the *Valentinians* and *Gnosticks* had their first Beginnings. *Iren. l. 1. c. 13.*

As this Way of short Writing by the first Letters, was of ancient Use amongst the *Jews*, so likewise amongst the *Romans*, which appears from many of their Contractions yet remaining, as *S. P. D. Salutem plurimam dicit. S. Pq. R. Senatus populusque Romanus. C. R. Civis Romanus. U. C. Urbs condita.* And the like.

These single Letters were called *Syglæ*, *per Syncopen*, from the obsolete Word *Sigillæ*, whence *Sigillatim.* They were usually inscribed in their Coins, Statues, Arms, Monuments, and Publick Records. You may see them largely treated of by *Valerius Probus*, where he affirms the Study of them to be very necessary for one that would understand the *Roman* Affairs. *His enim exprimebant nomina Curiarum, Tribuum, Comitiorum, Sacerdotiorum, Potestatum, Magistratuum, Præfecturarum, Sacrorum ludorum, Rerum Urbanarum, Rerum militarium, Collegiorum, Decuriarum, Fastorum, Numerorum, Mensurarum, Juris civilis, & similium.* *Lib. de liter. antiquis.* As it is set forth by *Jacobus Mazochius.*

They were first used by their Notaries, at Senates and other Publick Assemblies, and from thence re-

tained in their Statutes and Civil Laws: Whence *Manilius* makes it the Note of a good Lawyer.

——*Qui legum tabulas & condita jura*
Noverit, atque notis levebus pendentia verba.

Isidor. Bibliand. de ratione com. ling. Pet. Crinit. Honest. Disc. l. 6. c. 8.

Thus (saith *Isidor*) (A) inversed ∀ did formerly stand for *Pupilla*, and M inversed W for *Mulier*. By these Letters *D. E. R. I. C. P.* is signified, *De ea re ita censuerunt Patres.*

When the Judges were to inscribe their several Opinions on a little Stone or *Tessera*, to be cast into the Urn; by the Note *A*, they did absolve, by **K* condemn; by *N. L. Non liquet*, they did intimate that they could not tell what to make of the Business, and did therefore suspend their Judgments.

* From the *Greek*, καταδικάζειν.

But because of those many Ambiguities which this contracted Way of Writing was liable unto, and the great Inconveniences that might happen thereupon in the Misinterpretation of Laws; therefore the Emperor *Justinian* did afterward severely forbid any further Use of them, as it were, calling in all those Law-Books that were so written. *Neque enim licentiam aperimus ex tali codice in judicium aliquid recitari.*

Lib. 1. Cod. Tit. 17. leg. 3, 2.

The chief Purpose of these Ancient Abbreviations amongst the *Romans*, was properly for their speed. But it is easie to apprehend how by Compact they may be contrived also for Secresy.

CHAP.

CHAP. XI.

Of Writing by invented Characters.

The Distinction of these into such as signifie, either { Letters. Words. Notions.

The General Rules of unfolding and obscuring any Letter-characters. How to express any Sense, either by Points, or Lines, or Figures.

BEsides the Ways of secret Writing by the common Letters, there may likewise be divers others by invented Notes.

The Difference of Characters, whereby several Languages are expresst, is part of the second general Curse in the Confusion of Tongues; for as before there was but one Way of Speaking, so also but one Way of Writing. And as now, not only Nations, but particular Men, may discover their Thoughts by any different articulate Sounds, so likewise by any written Signs.

These invented Characters in the General, are distinguishable into such as signifie, either

1. *Letters.*
2. *Words.*
3. *Things, and Notions.*

First, concerning those that signify Letters: To which kind some Learned Men refer the *Hebrew* Character that is now in use; affirming, that *Ezra* first invented it, thereby the better to conceal the Secrets of their Law, and that they might not have so much as their Manner of Writing common with the *Samaritans* and other Schismaticks.

The Letter-character. *Hieronym. præf. ad l. Regum. Joseph Scal. notis ad Euseb.*

'Twere but needless to set down any Particulars of this kind, since it is so easy for any ordinary Man to invent or vary them at Pleasure.

The Rules that are usually prescribed for the unfolding of such Characters, are briefly these.

1. Endeavour to distinguish betwixt the Vowels and Consonants. The Vowels may be known by their Frequency, there being no Word without some of them. If there be any single Character in *English*, it must be one of these three Vowels, *a, i, o.*

2. Search after the several Powers of the Letters: For the understanding of this, you must mark which of them are most common, and which more seldom used. (This the Printers in any Language can easily inform you of, who do accordingly provide their Sets of Letters.) Which of them may be doubled, and which not, as *H*, *Q*, *X*, *Y*. And then, for the Number of Vowels or Consonants in the Beginning, Middle, or End of Words, a Man must provide several Tables, whence he may readily guess at any Word, from the Number and Nature of the Letters that make it: As, what Words consist only of Vowels; what have one Vowel, and one Consonant; whether the Vowel be first, as in these Words, *Am, an, as, if, in, is, it, of, on, or, us*; or last, as in these Words, *Be, he, me, by, dy, ly, my, ty, do, to, so,* &c. And so for all other Words, according to their several Quantities and Natures.

These Tables must be various, according to the Difference of Languages. There are divers the like Rules to be observed, which are too tedious to recite; you may see them largely handled by *Baptista Porta*, and *Gustavus Selenus*.

The

The common Rules of unfolding being once known, a Man may the better tell how to delude them; either by leaving out those Letters that are of less Use, as *H*, *K*, *Q*, *X*, *Y*; and putting other Characters instead of them, that shall signify the Vowels: So that the Number of this invented Alphabet will be perfect; and the Vowels, by reason of their double Character, less distinguishable. Or a Man may likewise delude the Rules of Discovery, by writing continuately, without any Distinction betwixt the Words, or with a false Distinction, or by inserting *Nulls* and *Non-significants*, &c.

In these cases Orthography is not to be regarded.

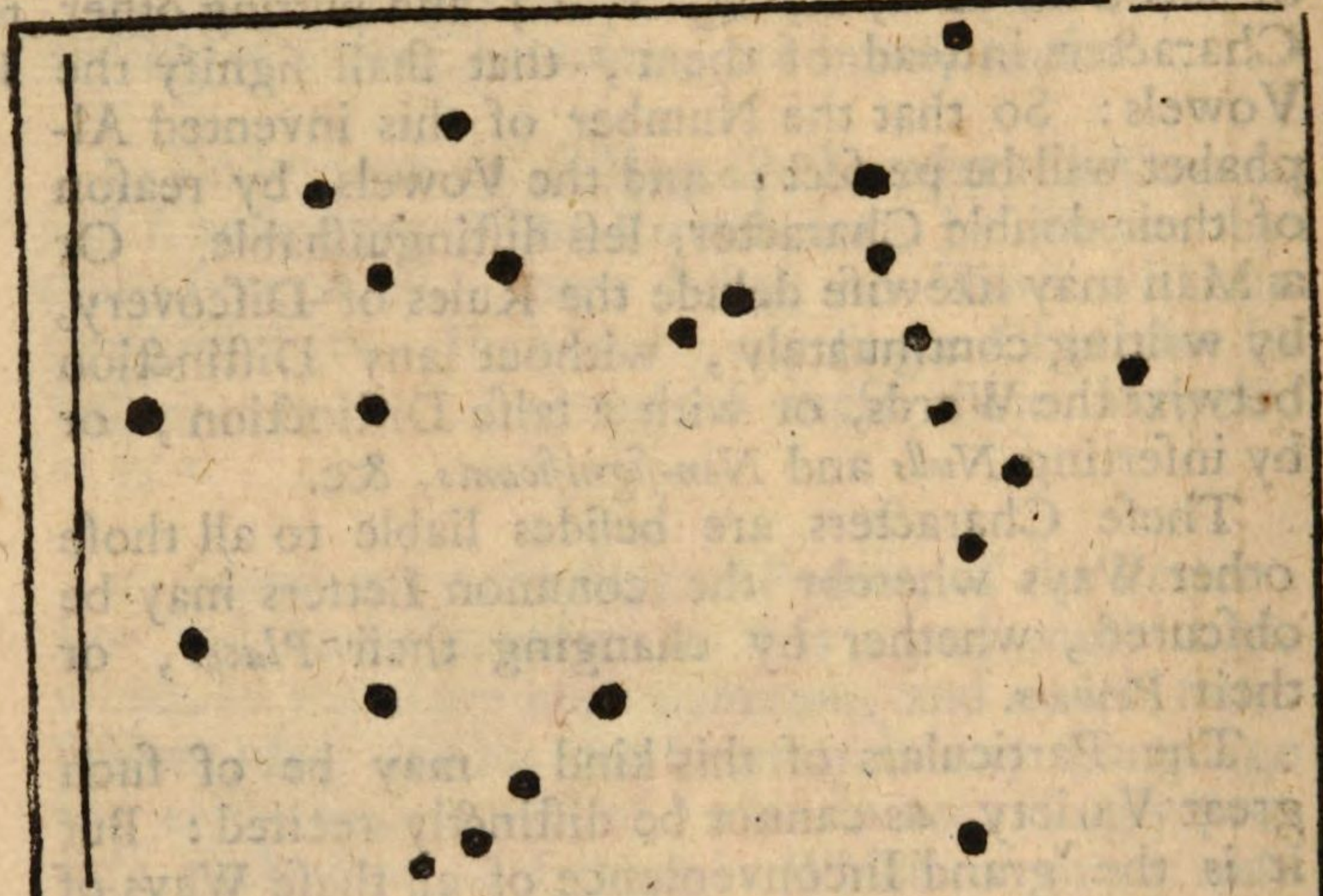
These Characters are besides liable to all those other Ways whereby the common Letters may be obscured, whether by changing their *Places*, or their *Powers*.

The Particulars of this kind, may be of such great Variety, as cannot be distinctly recited: But it is the grand Inconvenience of all these Ways of Secresy by invented Characters, that they are not without Suspicion.

For the remedying of which, there have been some other Inventions of writing by Points, or Lines, or Figures; wherein a Man would never mistrust any private Message, there being nothing to be discerned in these Kinds of Intimation, but only either some Confused and Casual, or else some Mathematical Descriptions; as you may see in these following Examples.

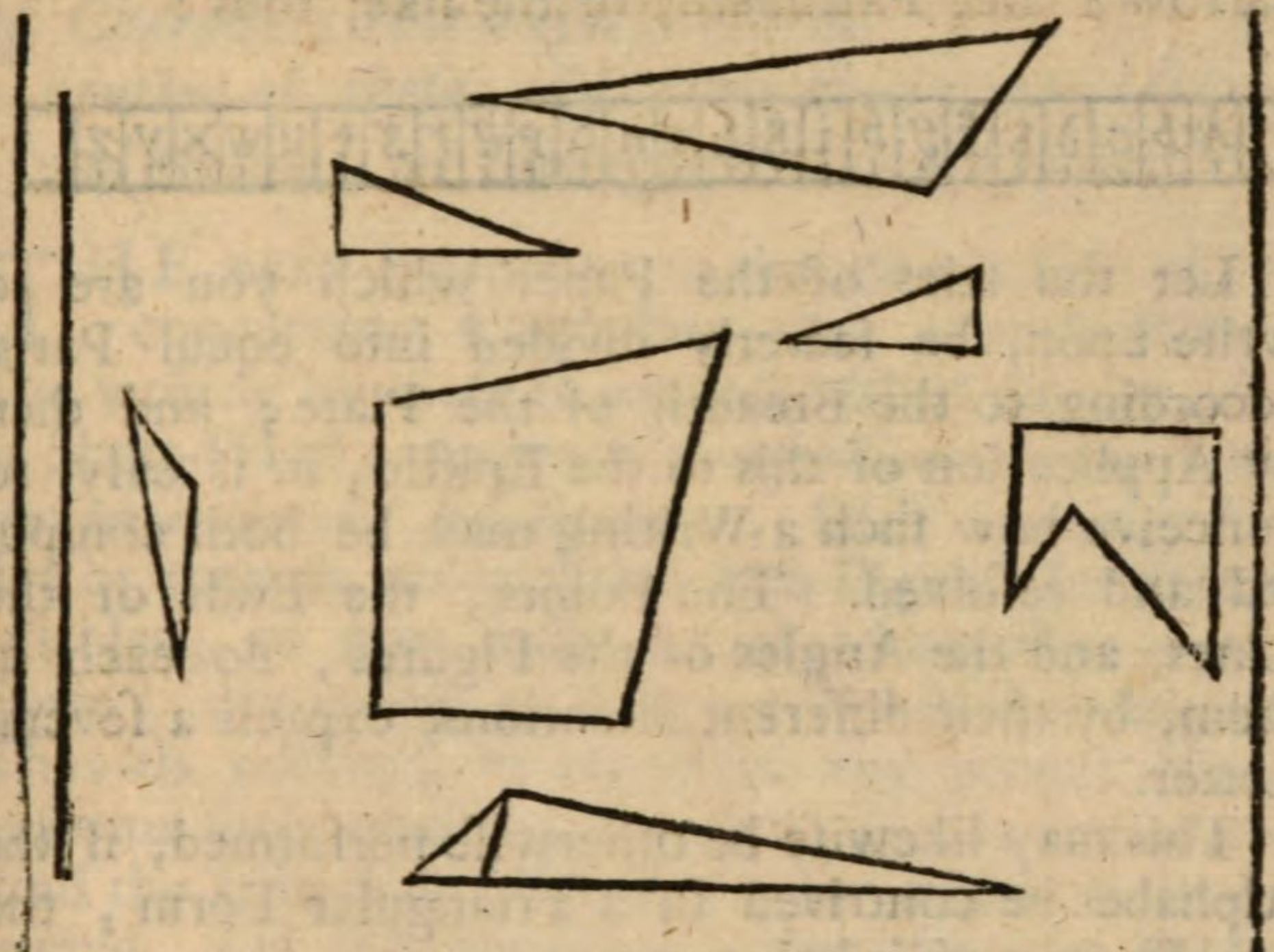
By

By Points alone.

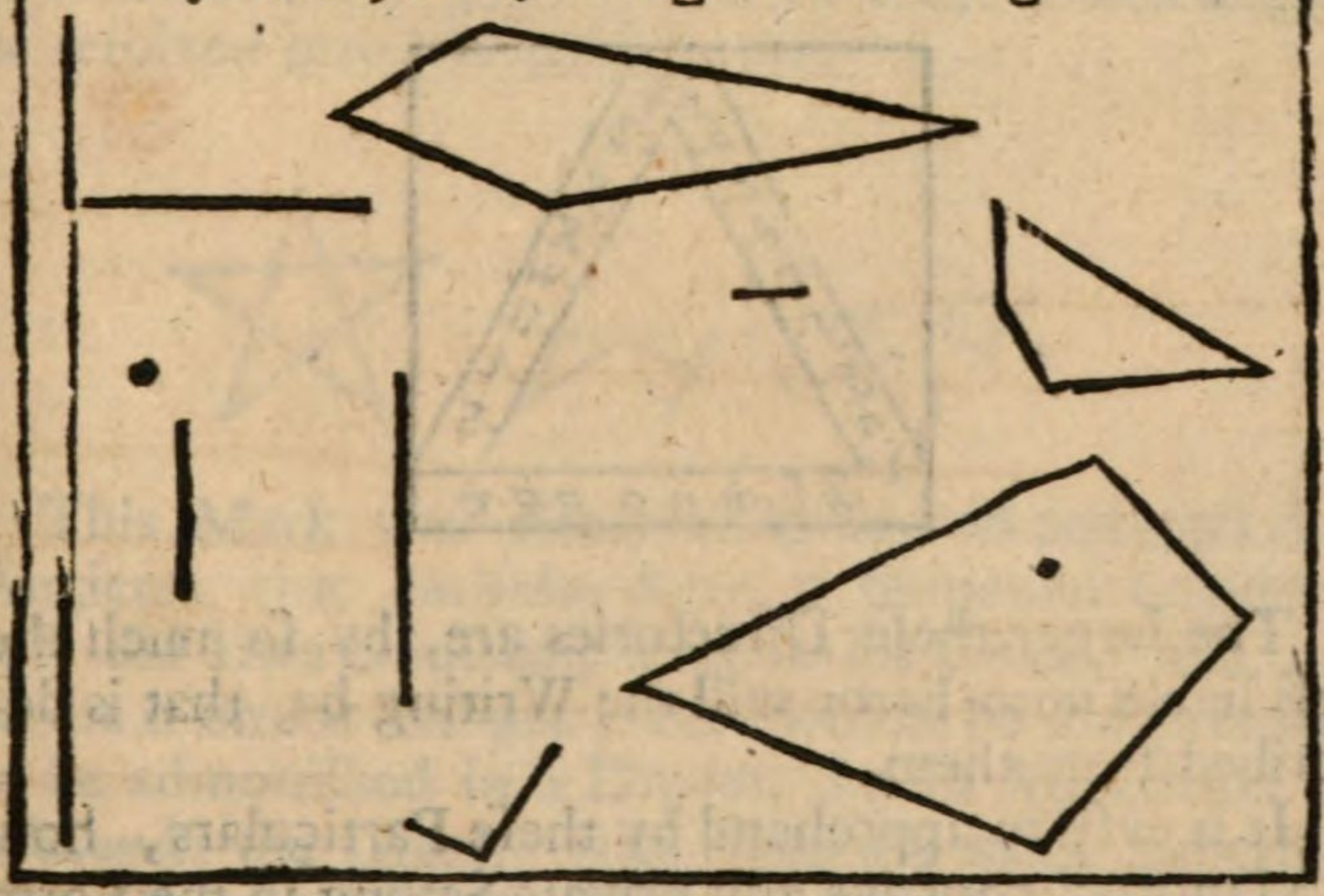


By Lines alone.

By Mathematical Figures.



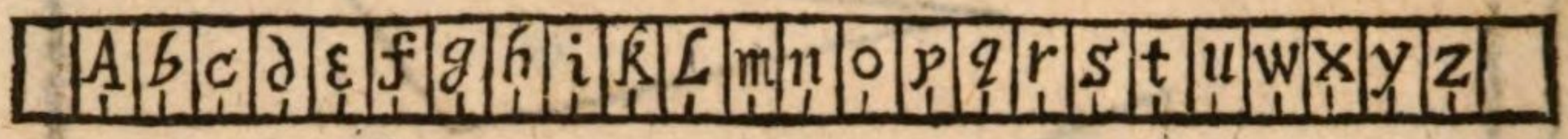
By Points, Lines, and Figures mixed together.



Each of which Figures do expreſs theſe Words:

There is no Safety but by Flight.

The Direction both for the making and unfolding of these Descriptions, is this: Let the Alphabet be described at equal Distances, upon some thin and narrow Plate, Pastboard, or the like, thus:



Let the sides of the Paper which you are to write upon, be secretly divided into equal Parts, according to the Breadth of the Plate; and then by Application of this to the Epistle, it is easy to conceive how such a Writing may be both composed and resolved. The Points, the Ends of the Lines, and the Angles of the Figures, do each of them, by their different Situations, express a several Letter.

This may likewise be otherwise performed, if the Alphabet be contrived in a Triangular Form, the Middle Part of it being cut out.

And so for a Square or round Form.

The larger these Directories are, by so much the less liable unto Error will the Writing be, that is described from them.

Joh. Walchius, Fab. 9.

It is easy to apprehend by these Particulars, how a Man may contrive any private Saying in the Form of a Landskip, or other Picture. There may be divers the like Ways, whereby this Invention of Secresy may be further obscured; but they are in themselves so obvious, that they need not any larger Explication.

CHAP.

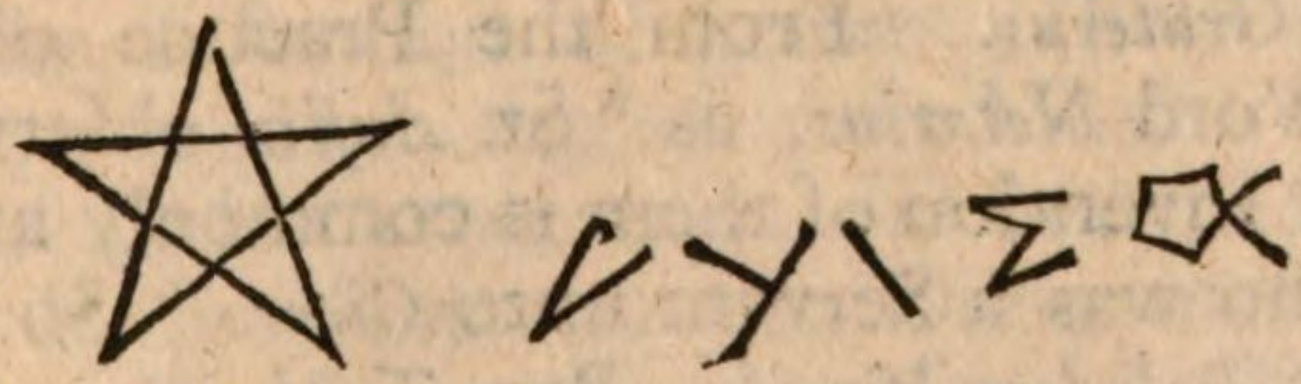
CHAP. XII.

Of Characters that express Words. The first Invention of these. Of those that signify Things and Notions, as Hieroglyphicks, Emblems.

THE next Particular to be discoursed of, is, concerning Characters that express Words. The writing by these is properly stiled *Stenography*, or Short-Hand; *Scripturæ Compendium, cum verba non perscribimus, sed signamus*, saith *Lypsius*. The Art of them is, to contrive such Figures for several Sylables, as may easily be joined together in one Form, according as different Words shall require. Thus 'tis ordinary to represent any proper Name by some such unusual Character, as may contain in it all the Letters of that Name for which it is intended. Of this Nature was that Angular Figure so much used by the *Græcians* of old, which might be resolved into the Letters *υγιεα*.

Cent. 1. ad Belg. Epist. 27.

Schikard Happer. Disp. 5.



This Mark was esteemed so Sacred amongst the Ancients, that *Antiochus Soter*, a perpetual Conqueror, did always instamp it upon his Coin, and inscribe it on his Ensigns; unto which he did pretend to be admonished in a Dream, by an Apparition of *Alexander* the Great. And there are many Superstitious Women in these Times, who believe this to be so lucky a Character, that they always work it upon the Swadling Clothes of their Young Children, thinking thereby to make them more healthful and prosperous in their Lives.. Unto this kind also,

also, some refer the Characters that are used in Magick, which are maintained to have, not only a secret Signification, but likewise a natural Efficacy.

This Short-hand Writing is now so ordinary in Practice (it being usual for any common Mechanick both to write and invent it) that I shall not need to set down any particular Example of it. In Ancient Times it was not so frequently used; but then there was a twofold Kind of it.

Private.
Publick.

And therefore *Pancirollus* reckons it amongst these later Inventions, *l. de Repert. tit.* 14. *Casaubon. notis in Æne. Poliorcet. c.* 31. *De notis Tyronis & Senec.*

These private Characters were practised by the *Roman* Magistates, and others of eminent Favour amongst them; who being often importuned to write in the Commendation of those Persons they knew not, were fain to agree upon some Secret Notes, whereby their *Serious* Epistles might be distinguished from those of *Form.* Whence the Proverb arose, *De meliori nota commendare.*

The other Characters of publick and common Use, are many of them explained by *Valerius Probus*, in his Book *de Literis Antiquis*; and there is a whole Volume, or Dictionary of them, set forth by *Janus Gruterus.* From the Practice of these came the Word *Notarius*, as * St. *Austin* observes.

* *De Doct. Christ. l.* 2. *c.* 26.

The first Invention of them is commonly ascribed to *Tyro*, who was a Servant unto *Cicero.* So * *Eusebius*, and † *Polydore Virgil.* But *Trithemius* affirms, That *Cicero* himself writ a Treatise on this Subject, which was afterwards augmented by St. *Cyprian*: And that he had found in an Old Library, the Copy of a Psalter written in these Characters, inscribed by some ignorant Man with this Title, *Psalterium in Lingua Armenica.*

* *In Chron.*
† *De invent. rerum l.* 2. *c.* 8. *De Polygr.*

That *Cicero* was not unacquainted with these Notes, may be evident from that Passage to *Atticus*: *Quod ad te de legatis scripsi, parum intellexit, credo, quia δι᾽ σημείων scripseram.*

Lib. 13. *ad Attic. Ep.* 32.

Pet.

Pet. Diaconus attributes the first Invention of these to the Old Poet *Ennius*; whose Beginnings in this kind, did afterwards receive successive Addition from the Works of *Tyro*, *Philargirus*, *Aquila*, and *Seneca* the Father; by whom they were increased to the Number of 5000. *Prolog. not. Conrad. Imp. Isidor. Orig. l. 1. c. 21.*

But *Hermannus Hugo*, a late Jesuit, will have this Short-hand Writing to be of far more ancient Use; affirming, that *David* alludes to the Practice of it, in that Phrase, *Psal.* 45. 1. *The Pen of a ready Writer.* And that the Writing upon the Wall, in *Dan.* 5. 25. which so puzzled the *Chaldean* Wizards, was described in such kind of Characters. But whether this were so, or not, is not much material: It is sufficiently pertinent to the present Enquiry, that the Use of these Word-Characters may well enough conduce to the Secresy of any written Message. *De Orig. scribendi, c. 18. juxta finem.*

The third and last sort of Signs, that have been anciently used for the Expression of *Things* and *Notions*, are either *Hieroglyphicks*, or *Emblems*.

1. Concerning *Hieroglyphicks.* The Word signifies *Sacred Sculptures*, which were engraven upon Pillars, Obelisks, Pyramids, and other Monuments, before the Invention of Letters. Thus the *Ægyptians* were wont to express their Minds, by the Pictures of such Creatures as did bear in them some natural Resemblance to the Thing intended. By the Shape of a Bee, they represented a King; intimating, that he should be endowed with Industry, Honey, and a Sting. By a Serpent, with his Tail in his Mouth, the Year, which returns into it self: And (which was a kind of Prophetical Hieroglyphick) by the Sign of a Cross, they did anciently denote *Spem venturæ Salutis*, or *Vitam Eternam*, as *Pet. Crinitus* relates out of *Ruffinus.* * *Philo* reckons up the Knowledge of these amongst those other abstruse *Ægyptian* Arts, wherein *Moses* is said to be so expert. And *Clemens* relates of *Pythagoras*, how he

Of Hieroglyphicks. *Tacit. Annal. l.* 11. *Pol. Virgil de Invent. l.* 3. *c.* 11. *De honesta disciplina l.* 7. *c.* 2. * *Lib. de vita Mosis. Lib.* 1. *Stromat.*

he was content to be circumcised, that so he might be admitted to the understanding of those many and great Mysteries which were this way delivered by the Ancient Priests, who did conceal all their Learning under such kind of Magical Expressions, as the Poet stiles them.

Lucan l. 3.

Nondum flumineas Memphis *contexere byblos*
Noverat, & saxis tantum volucresque feræque,
Sculptaq; servabant magicas animalia linguas.

Lib. de Isid. & Osiride.

Plutarch speaks of a Temple in *Ægygt* dedicated to *Minerva*, in the Front of which there was placed the Image of an *Infant*, an *Old Man*, a *Hawk*, by which they did represent God; a *Fish*, the Expression of Hatred; and a *Sea-horse*, the common Hieroglyphick of Impudence: The Construction of all being this; O *ye that are born to dye, know that God hateth Impudence.*

Herodot. Melpom. l. 4. *c.*130. *Cl. Alex. Strom.* 5.

Of this Nature were those Presents sent unto *Darius*, when he was almost wearied in his War against the *Scythians*; which were, a Bird, a Mouse, a Frog, and certain Arrows; intimating, that unless the *Persians* could fly as *Birds*, or hide themselves under Water as *Frogs*, or inhabit the Caverns of the Earth as *Mice*, they should not escape the *Scythian Arrows*. Of this kind likewise were some Military Signs amongst the *Romans*. When any thing was to be carry'd with Silence and Secresy, they lifted up the Representation of a *Minotaur*; thereby teaching the Captains, that their Counsels and Contrivances must be as inextricable as a Labyrinth, which is feigned to be the Habitation of that Monster.

Pierius Hieroglyph. l. 3. *c.* 38.

Emblems from the *Greek* Word ἐμβάλλειν, *interserere, injicere.*

2. Like unto these Hieroglyphicks, are the Expressions by Emblems. They were usually inserted as Ornaments upon Vessels of Gold, and other Matters of State or Pleasure. Of this Nature are the Stamps of many Ancient Medals, the Impresses of Arms, the Frontispieces of Books, *&c.*

The

The Kinds of them are chiefly twofold.

1. *Natural.* Which are grounded upon some Resemblance in the Property and Essence of the Things themselves. So a Dolphin, which is a swift Creature, being described upon an Anchor, which serves for the Stay and Rest of a Ship, signifies *Festinalente*, Deliberation in Counsel, and Dispatch in Execution: A Young Stork carrying the Old one, Filial Gratitude.

2. *Historical*, Those that refer to some common Relation. So the Picture of *Prometheus* gnawed by a Vulture, signifies the Desert of over-much Curiosity. *Phaeton*, the Folly of Rashness. *Narcissus*, the Punishment of Self-love.

It was formerly esteemed a great Sign of Wit and Invention, handsomely to convey any noted Saying under such kind of Expressions.

CHAP. XIII.

Concerning an Universal Character, that may be legible to all Nations and Languages. The Benefit and Possibility of this.

AFter the Fall of *Adam*, there were two General Curses inflicted on Mankind: The one upon their *Labours*, the other upon their *Language*.

Against the first of these we do naturally endeavour to provide, by all those common Arts and Professions about which the World is busied; seeking thereby to abate the Sweat of their Brows in the Earning of their Bread.

Against the other, the best Help that we can yet boast of, is the *Latin* Tongue, and the other learned Languages, which by Reason of their Generality, do somewhat restore us from the first Confusion. But

now if there were such an Universal Character to express Things and Notions, as might be legible to all People and Countries, so that Men of several Nations might with the same ease both write and read it, this Invention would be a far greater Advantage in this Particular, and mightily conduce to the spreading and promoting of all Arts and Sciences: Because that great part of our Time which is now required to the Learning of Words, might then be employed in the Study of Things. Nay, the Confusion at *Babel* might this Way have been remedied, if every one could have expressed his own meaning by the same kind of Character. But then perhaps the Art of Letters was not invented.

That such a manner of Writing is already used in some Parts of the World, the Kingdoms of the high *Levant*, may evidently appear from divers credible Relations. *Trigaultius* affirms, that though those of *China* and *Japan*, do as much differ in their Language as the *Hebrew* and the *Dutch*; yet either of them can, by this Help of a common Character, as well understand the Books and Letters of the others, as if they were only their own.

Histor. Sinens. l. 1. c. 5.

Bacon Augment. Scient. l. 6. c. 13.

Voss. Gr. l. 1. c. 41.

Herm. Hugo de Orig. Scrib. c. 4.

And for some particulars, this general kind of Writing is already attained amongst us also.

1. Many Nations do agree in the Characters of the common Numbers, describing them either the *Roman* Way by Letters, as I. II. V. X. C. D. M. or else the *Barbarian* Way by Figures, as 1. 2. 3. 10. *&c.* So likewise for that which we call Philosophical Number, which is any such Measure whereby we judge the Differences betwixt several Substances, whether in Weight, or Length, or Capacity; each of these are expresst in several Languages by the same Character. Thus ℈ signifies a Scruple, ℥ a Drachm, and so of the rest.

2. The Astronomers of several Countries do express

preſs both the Heavenly Signs, and Planets, and Aſpects by the ſame kind of Notes: As, ♈, ♉, ♊, ♋, &c. ♄, ♃, ♂, ♀, &c. ☌, ✶, △, □, ☍. Which Characters (as it is thought) were firſt invented by the Ancient Aſtrologers for the Secreſy of them, the better to conceal their Sacred and Myſterious Profeſſion from vulgar Capacity.

3. The Chymical Treatiſes that are written in different Languages, do all of them agree in the ſame Form of Writing their Minerals. Thoſe that are attributed to any of the Planets, are decyphered by the Character of the Planet to which they belong. The reſt by other particular Signs, as △ for Salt Ammoniack, ☍ for Arſnick, *&c.*

4. Muſical Notes in moſt Countries are the ſame: Nor is there any reaſon why there may not be ſuch a general kind of Writing invented for the Expreſſion of every Thing elſe as well as theſe particulars.

In the Contrivance of this there muſt be as many ſeveral Characters as there are primitive Words. To which purpoſe the *Hebrew* is the beſt Pattern, becauſe that Language conſiſts of feweſt Radicals.

Each of theſe Primitives muſt have ſome particular Marks to diſtinguiſh the Caſes, Conjugations, or other neceſſary Variations of thoſe Derivatives that depend upon it.

In the Reading of ſuch a Writing, though Men of ſeveral Countries ſhould each of them differ in their Voices, and pronouncing ſeveral Words, yet the Senſe would be ſtill the ſame. As it is in the Picture of a Man, a Horſe, or Tree; which to all Nations do expreſs the ſame Conceit, though each of theſe Creatures be ſtiled by ſeveral Names, according to the Difference of Languages.

Suppoſe that Aſtronomical Sign ♉ were to be pronounced, a *Jew* would call it שור; a *Grecian*, Ταῦρον; an *Italian*, *Toro*; a *Frenchman*, *Taureau*; a *German*, *Stier*; an *Engliſhman*, a *Bull*.

So likewise for that Character, which in *Tiro's* Notes signifies the World, a *Few* would read it תבל; a *Grecian*, Κόσμος; an *Italian*, *il monde*; a *Frenchman*, *le monde*; a *German*, *Belt*. Though several Nations may differ in the *Expression* of things, yet they all agree in the same Conceit of them.

The Learning of this Character will not be more difficult than the Learning of any one Language, because there needs not be more Signs for the Expression of Things, than there is now for the Expression of *Words*. Amongst those in *China* and *Japan*, there is said to be about Seven or Eight Thousand.

The perfecting of such an Invention were the only Way to unite the Seventy two Languages of the first Confusion; and therefore may very well deserve their Endeavours who have both Abilities and Leisure for such kind of Enquiries.

CHAP. XIV.

Concerning the third Way of Secret Discoursing by Signs and Gestures, which may signifie, either

ex { congruo. / placito.

THE third Way of Discoursing was by Signs and Gestures, which (as they are serviceable to this Purpose) may be distinguished into such as are significant, either

1. *Ex congruo.*
2. Or *ex placito.*

1. *Ex congruo*, when there is some natural Resemblance

blance and Affinity betwixt the Action done, and the thing to be expreſt. Of which kind are all thoſe outward Geſtures, whereby not only dumb Creatures, but Men alſo do expreſs their inward Paſſions, whether of Joy, Anger, Fear, *&c.* For,

Sæpe tacens vocem verbaque vultus habet.

And the Wiſe Man notes it of the Scorner, That *he winketh with his eyes, he ſpeaketh with his feet, he teacheth with his fingers.* Prov. 6. 13.

Of this kind likewiſe are many Religious Actions, and Circumſtances of Divine Worſhip, not only amongſt the Ancient Heathen, but ſome that were particularly enjoyned the Prieſts and *Levites* of the old Law; and ſome too that are now in Uſe in theſe Times of the Goſpel. For by ſuch bodily Geſtures and Signs, we may as well ſpeak unto God as unto Men.

To this kind alſo are reducible thoſe Actions of *Form*, that are required as neceſſary Circumſtances in many civil Affairs and publick Solemnities, which are uſually ſuch, as in themſelves are apt to ſignifie the thing for which they are meant.

But now ſometimes the intended meaning of theſe Geſtures is concealed under a ſecret Similitude. As it was in that Act of *Thraſybulus*, who being conſulted with, how to maintain a Tyranny that was newly uſurped: He bid the Meſſenger attend him in the Field; where with his Wand he whipt off thoſe higher Ears of Corn that did over-top the reſt; intimating, that it conſiſted in cutting off the Peers and Nobility, who were likely to be moſt impatient of Subjection. This I may call a *Parabolical* Way of ſpeaking by Geſtures.

2. *Ex placito*, when theſe Signs have their Signification from Uſe and mutual Compact; which kind of Speaking, as it refers to laſcivious Intimations, is largely handled by *Ovid*, *de Arte amandi*.

Verba superciliis sine voce loquentia dicam,
Verba leges digitis, &c.

By the Help of this it is common for Men of several Nations, who understand not one another's Languages, to entertain a mutual Commerce and Traffick. And 'tis a strange thing to behold, what Dialogues of Gestures there will pass betwixt such as are born both Deaf and Dumb; who are able by this means alone, to answer and reply unto one another as directly as if they had the Benefit of Speech. 'Tis a great part of the State and Majesty belonging to the *Turkish* Emperor, that he is attended by Mutes, with whom he may discourse concerning any private Business, which he would not have others to understand.

It were a miserable thing for a Rational Soul to be imprisoned in such a Body as had no Way at all to express its Cogitations; which would be so in all that are born Deaf, if that which Nature denied them, were not in this Respect supplied by a second Nature, Custom and Use.

But (by the Way) 'tis very observable which * *Vallesius* relates of *Pet. Pontius* a Friend of his, who by an unheard-of Art taught the Deaf to speak. *Docens primum scribere, res ipsas digito indicando, quæ characteribus illis significarentur; deinde ad motus linguæ, qui characteribus responderent provocando.* First learning them to write the Name of any thing he should point to; and afterwards provoking them to such Motions of the Tongue as might answer the several Words. 'Tis probable that this Invention well followed, might be of singular Use for those that stand in need of such Helps. Tho' certainly that was far beyond it, (if true) which is related of an ancient Doctor, *Gabriel Neale*, that he could understand any Word by the meer Motion of the Lips, without any Utterance.

* *Sacra Philos. c.* 3.

The particular Ways of Discoursing by Gestures, are not to be numbred, as being almost of infinite Variety, according as the several Fancies of Men

shall

ſhall impoſe Significations upon all ſuch Signs or Actions as are capable of ſufficient Difference.

But ſome there are of more eſpecial Note for their Uſe and Antiquity. Such is that upon the Joynts and Fingers of the Hand, commonly ſtiled *Arthrologia*, or *Dactylologia*; largely treated of by the venerable * *Bede*, † *Pierius*, and others. In whom you may ſee, how the Ancients were wont to expreſs any Number by the ſeveral Poſtures of the Hands and Fingers: The Numbers under a hundred, were denoted by the Left Hand, and thoſe above, by the Right Hand. Hence *Juvenal*, commending *Pylias* for his old Age, ſays, That he reckoned his Years upon his Right Hand.

Fælix nimirum qui tot per ſæcula vitam
Diſtulit, atque ſuos jam dextra computat annos.

There are divers Paſſages in the Ancient Authors, both Sacred and Prophane, which do evidently allude to this kind of reckoning.

Hence it is eaſie to conceive, how the Letters as well as the Numbers, may be thus applied to the ſeveral Parts of the Hand, ſo that a Man might with divers Touches, make up any Senſe that he hath occaſion to diſcover unto a Confederate.

This may be performed, either as the Numbers are ſet down in the Authors before-cited; or elſe by any other Way of Compact that may be agreed upon.

As for Example: Let the Tops of the Fingers ſignifie the five Vowels; the middle Parts, the five firſt Conſonants; the Bottoms of them, the five next Conſonants; the Spaces betwixt the Fingers the four next. One Finger laid on the ſide of the Hand may ſignifie T, two Fingers V the Conſonant, three W, the little Finger croſſed X, the Wriſt Y, the middle of the Hand Z.

But becauſe ſuch various Geſticulations as are required to this, will not be without Suſpicion, therefore it were a better Way, to impoſe Significations

* *Lib. de loquelâ per geſtum digitorum ſive de indigitatione.*
† *Hieroglyphic. l.* 37. *c.* 1. &c. *Cælius Antiq. lect. l.* 23. *c.* 12. *Satyr.* 10.

upon such Actions as are of more common unsuspected Use; as scratching of the Head, rubbing the several Parts of the Face, winking of the Eyes, twisting of the Beard, *&c.* Any of which, or all of them together, may be as well contrived to serve for this Purpose, and with much more Secresy.

In which Art, if our gaming Cheats, and *Popish* Miracle-Impostors, were but well versed, it might much advantage them, in their cozening Trade of Life.

CHAP. XV.

Concerning the Swiftness of Informations, either by Qualities, as the Impression of Imagination, and the Sensitive Species; or by Spiritual Substances, as Angels.

HAving already treated concerning the several Ways of *Secresy* in Discoursing; I shall in the next Place enquire, How a Man may with the greatest Swiftness and Speed, discover his Intentions to one that is far distant from him.

There is nothing (we say) so swift as Thought, and yet the Impression of these in another, might be as quick almost as the first Act, if there were but such a great Power in Imagination, as some later * Philosophers have attributed to it.

* *Marsil. Ficin. Theolog. Platon. l. 3. c. 1. Pomponatius de Incantat. Paracelsus.*

Next to the Acts of Thought, the Species of Sight do seem to be of the quickest Motion. We see the Light of the *East* will in a Moment fill the Hemisphere, and the Eye does presently discern an Object that is very remote. How we may by this means communicate our Thoughts at great Distances, I shall discourse afterwards.

The

The Substances that are most considerable for the Swiftness of their Motion, are

Either { *Spiritual.* / *Corporeal.*

Spirits.

Amongst all created Substances, there are not any of so swift a Motion as Angels or Spirits. Because there is not either within their Natures, any such Indisposition and Reluctancy, or without them in the Medium, any such Impediment as may in the least manner retard their Courses. And therefore have the Ancient Philosophers employed these as the Causes of that mad Celerity of the Celestial Orbs; tho' according to their Suppositions, I think it would be a hard Match, if there were a Race to be run betwixt the *Primum Mobile* and an Angel. It being granted that neither of them could move in an Instant, it would be but an even lay which should prove the swifter.

מלאך *ἀγγελος Angelus.*

From the Fitness of Spirits in this regard to convey any Message, are they in the learned Languages called Messengers.

Plutarch. Maximus Tyrius. Dissertat. 26, 27.

Now if a Man had but such Familiarity with one of these, as *Socrates* is said to have with his Tutelary *Genius*: If we could send but one of them upon any Errand, there would be no quicker Way than this for the Dispatch of Business at all Distances.

Lactant. Inst. l. 2. ep. 8. Val. Max. l. 1. c. 8. Florus, lib. 2. c. 12.

That they have been often thus employed, is affirmed by divers Relations. *Vatinius* being at *Rome*, was informed by an Apparition of that Victory which *Paulus* their General had obtained over King *Perses* in *Macedon*, the very same Day wherein the Battel was fought; which was a long Time before any other Messenger could arrive with the News.

And it is storied of many others, that whilst they have resided in remote Countries, they have known the Death of their Friends, even in the very Hour of their Departure; either by Bleeding, or by Dreams, or some such Way of Intimation. Which, though it be

be commonly attributed to the Operation of Sympathy; yet it is more probably to be ascribed unto the Spirit or Genius. There being a more especial Acquaintance and Commerce betwixt the Tutelary Angels of particular Friends, they are sometimes by them informed (tho' at great Distances) of such Remarkable Accidents as befall one another.

But this way there is little Hopes to advantage our Enquiry, because it is not so easie to employ a good Angel, nor safe dealing with a bad one.

The Abbot *Trithemius*, in his Books concerning the several Ways of secret and speedy Discoursing, does pretend to handle the Forms of Conjuration, calling each kind of Character by the Name of Spirits, thereby to deter the Vulgar from searching into his Works. But under this Pretence, he is thought also to deliver some Diabolical Magick. Especially in one Place, where he speaks of the three Saturnine Angels, and certain Images, by which, in the Space of twenty four Hours, a Man may be informed of News from any Part of the World. And this was the mainReason, why by *Junius* his Advice, *Frederick* the Second, Prince *Palatine*, did cause the Original Manuscript of that Work to be burned. Which Action is so much (though it should seem unjustly) blamed by *Selenus*.

Vossius Gram. l. 1. c. 41.

Polygraph. l. 3. c. 16.

Cryptogr. l. 3. c. 15.

CHAP. XVI.

Concerning the Swiftness of Conveyance by Bodies, *whether* Inanimate, *as Arrows, Bullets; or* Animate, *as Men, Beasts, Birds.*

THE *Bodies* that are most eminent for their Swiftness, may be distinguished into such as are

Either

Either { *Inanimate.* / *Animate.*

Inanimate Bodies.

These Inanimate Bodies, as Arrows, Bullets, *&c.* have only a violent Motion; which cannot therefore be continued to so great a Distance, as some Occasions would require: But for so much Space as they do move, they are far swifter than the Natural Motion of any Animated Body. How these have been contrived to the speedy Conveyance of Secret Messages, hath been formerly discoursed, in the Fourth Chapter, which I now forbear to repeat.

Those Living Bodies that are most observable for their Speed and Celerity in Messages, are either Men, Beasts, Birds: Tho' I doubt not, but that Fishes also may be serviceable for this purpose, especially the Dolphin, which is reported to be of the greatest Swiftness, and most easily circurated, or made tame.

Men.

Amongst the Ancient Footmen, there are some upon Record for their incredible Swiftness. *Lædas* is reported to be so quick in his Running, *Ut arenis pendentibus & cavo pulvere, nulla indicia relinqueret vestigiorum*; that he left no Impression of his Footsteps on the Hollow Sands. And it is related of a Boy amongst the *Romans*, being but Eight Years old, that did run Five and forty Miles in an Afternoon. *Anistius* and *Philonides*, two Footmen unto *Alexander* the Great, are said to have run 1200 *Stadia* in a day. Which Relations will seem less incredible, if we consider the Ancient Exercises and Games of this kind, together with the publick Fame and Rewards for those that were most eminent.

Solinus Polyhist. c. 6.

Ibid.

Swiftness of Beasts. *Exer.* 205.

Amongst the Variety of Beasts, there are some of more especial Note for their Strength and Swiftness. *Scaliger* mentions a Story, (tho' he distrusts the Truth of it) of a certain Beast called *Ellend*,

two

two of which being joined in a little Cart, are said to pass Three hundred Leagues a day upon the Ice.

In former Ages, and in other Countries, the Dromedary, and Camel, and Mule, were of more common Use; but in these Times and Places, the Horse (for the most part) serves instead of them all; by the Help of which, we have our swiftest Means of ordinary Conveyance. The Custom of Riding Post, by renewing both Horse and Man at set Stages, is of Ancient Invention. *Herodotus* re-
Lib. 8. 98. lates it to be used by *Xerxes* in the *Grecian* War; and that it was by the *Persians* called Ἀγγαρηῖον. The Particulars that concern these kind of Conveyances amongst the Ancients, are largely handled by *Hermannus Hugo*, *Lib.* 3. *de Origine scribendi*, *c.* 14.

Pliny tells us of certain Mares in *Lusitania*, which
Nat. Hist. l. 8. *c.* 42. do conceive meerly by the *West* Wind; that alone (without the Copulation of any Male) serving to actuate their Heat, and to generate their Young.
Georg. 3. Which are likewise mentioned by *Virgil*:

Exceptantq; auras leves, & sæpe sine ullis
Conjugiis, vento gravidæ, &c.

Methinks these Children of the Wind should, for their Fleetness, make excellent Post-Horses, and much conduce to the speedy Conveyance of any Message.

The *Paracelsians* talk of Natural Means to extract the Mettle and Spirit out of one Horse; and infuse it into another; of enabling them to carry a Man safely and swiftly through Enemies, Precipices, or other dangerous Places. And such Horses (say they) were used by the Wise Men of the *East* at our Saviour's Nativity; for they had not otherwise been able to have kept pace with a Star, or to have passed so great a Journey as it was to *Jerusalem*, which is thought to be Five or Six hundred Miles at the least, from the Places of their Habitation. If this Conceit were feasible, it would much promote the

the Speed of Conveyances; but I think it may justly be referred amongst the other Dreams of the Melancholick Chymicks.

The Swiftness of Birds.

Amongst all Animate Bodies, there is not any that have naturally so swift a Motion as Birds; which if a Man could well employ in the Dispatch of any Errand, there would be but little Fear that such Messenger should be either intercepted, or corrupted.

That this hath been attempted, and effected by many of the Ancients, is affirmed by divers Relations. *Pliny* tells us of *Volaterranus*, that he discover'd a Conquest he had gotten unto the City of *Rome*, by sending out Swallows, which should fly thither, being anointed over with the Colour of Victory. And of another, who sending one of these Birds into a besieged City, (whence she was before taken from her young ones) and tying a String unto her with certain Knots upon it, did thereby shew, after what Number of Days their Aids would come; at which time they should make an Irruption upon the Enemy.

Nat. Hist. l. 10. *c.*24.

And elsewhere, in the same Book, he relates, How *Hircius* the Consul, and *Brutus* who was besieged in *Mutina*, did this way maintain mutual Intelligence, by tying their Letters unto such Pigeons, as were taught beforehand to fly from the Tents to the City, and from thence to the Tents again.

Cap. 37.

How *Thaurosthenes* did by this means send the News of his Victory at *Olympia*, to his Father at *Ægina*, is related by *Ælian*.

Hist. Animalium, l. 6. *c.* 7.

Anacreon has an Ode upon such a Pigeon, which he himself had often used as a Messenger, wherein the Bird is feigned to say,

Ἐγὼ δ' Ἀνακρέοντι
Διακονῶ τοσαῦτα
Καὶ νυῦν ὁρᾷς ἐκεῖνα
Ἐπιστολὰς κομίζω.

Unto

Sat. 4. juxta fin.

Unto this Invention also, *Juvenal* is thought to allude; where he says,

——— *Tanquam è diversis partibus orbis,*
Anxia præcipiti venisset Epistola pennâ.

Saturn. Serm. l. 2. c. 6.

Lypsius relates out of *Varro*, That it was usual for the *Roman* Magistrates when they went unto the Theatre, or other such publick Meetings, whence they could not return at pleasure, to carry such a Pigeon with them; that if any unexpected Business should happen, they might thereby give Warning to their Friends or Families at home.

By which Relations you may see how commonly this Invention was practised amongst the Ancients. Nor hath it been less used in these later Times, especially in those Countries where by reason of continual Wars and Dissentions, there have been more particular and urgent Necessity for such kind of Conveyances. *Nunc vulgatissima res est, columbas habere, ad ejusmodi jussa paratas*, saith *Casaubon*. *Not. in Æneæ Poliorcet. c. 31. Comment. in Veget. l. 3. c. 5.* *Harum opere, nostrates hoc bello civili, frequenter adjuti sunt*, saith *Godesc. Stewechius*.

There are divers other Stories to this purpose, but by these you may sufficiently discern the common Practices of this kind. As it is usual to bring up Birds of Prey, as Hawks, Cormorants, *&c.* to an Obedience of their Keepers; so likewise have some attempted it in these other Birds, teaching them the Art of carrying Messages. There is a smaller sort of Pigeon, of a light Body, and swift Flight, which is usually made choice of for such particulars; and therefore the kind of them is commonly called by the Name of Carriers.

See *Nunt. Inanimat.* concerning *Amiraldus. Porta de furt. lit. l. 2. c. 21.* concerning Marches. *Herm. Hugo de Orig. scribendi, c. 15. Thuanus Hist. l. 17.*

CHAP.

CHAP. XVII.

Of Secret and Swift Informations by the Species of Sound.

HAving in the former Chapters treated severally concerning the divers Ways of Secresy and Swiftness in Discourse; it remains that I now enquire, (according to the Method proposed) how both these may be joined together in the Conveyance of any Message. The Resolution of which, so far as it concerns the Particulars already specify'd, were but needless to repeat.

That which does more immediately belong to the present *Quære*, and was the main Occasion of this Discourse, does refer to other Ways of Intimation, besides these in ordinary Use, of Speaking, or Writing, or Gestures. For in the general we must note, That *whatever is capable of a competent Difference, perceptible to any Sense, may be a sufficient Means whereby to express the Cogitations.* It is more convenient, indeed, that these Differences should be of as great Variety as the Letters of the Alphabet; but it is sufficient if they be but twofold, because Two alone may, with somewhat more Labour and Time, be well enough contrived to express all the rest. Thus any two Letters or Numbers, suppose A. B. being transposed through five Places, will yield Thirty two Differences, and so consequently will superabundantly serve for the Four and twenty Letters, as was before more largely explained in the Ninth Chapter.

Now the Sensitive Species, whereby such Informations must be conveyed, are, either the Species of *Sound*, or the Species of *Sight*: The Ear and the Eye being the only Senses that are of quick Perception, when their Objects are remote.

Vege-

De re mi-lit. l. 3. c. 5.

Vegetius distinguisheth all significatory Signs into these Three Sorts.

1. *Vocalia.* By articulate Sounds.
2. *Semivocalia.* By inarticulate Sounds.
3. *Muta.* By the Species of Sight.

The two last of these are chiefly pertinent to the present Enquiry. Concerning which, in the General it may be concluded, that any Sound, whether of Trumpets, Bells, Cannons, Drums, *&c.* or any Object of Sight, whether Flame, Smoak, *&c.* which is capable of a double Difference, may be a sufficient Means whereby to communicate the Thoughts.

The particular Application of these, to some Experiments, I shall treat more distinctly in the Remainder of this Discourse.

Secret and speedy Information by the Species of Sound.

First, Concerning the Secresy and Swiftness of any Message by the Species of Sound. Though these audible Species be much slower than those of Sight, yet are they far swifter than the natural Motion of any corporeal Messenger. The chief Use of these is for such as are within some competent Nearness, as perhaps a Mile off. But they may also by frequent Multiplication be continued to a far greater Distance.

Proœm. in lib. Plutar. de defectu oraculorum.

There is a Relation in *Joach. Camerarius*, of some that have heard their Friends speaking to them distinctly, when they have been many Miles asunder. *Habui notos homines, neque leves, & non indoctos, qui affirmabant, se audiisse secum colloquentes diserte, eos quos tunc multorum millium passuum abesse certe scirent.* But this he justly refers to Diabolical Magick, and the Illusion of Spirits.

De rerum Inventor. lib. 2.

There are other *natural* Experiments in this kind, of more especial Note for their Antiquity. Such was that of King *Zerxes*, related by *Cleomenes*, as he is cited by *Sardus*. Cleomenes *in libro de circulis cœlestibus scribit* Xerxem *toto itinere à* Perside *in* Græciam *stationes statuisse, & in iis homines ita prope, ut vocem alterius*

terius alter exaudiret; quo modo quadraginta horarum spatio, ex Græciâ *in* Persidem *res nunciari poterat.* But this Invention, besides the great Trouble and Uncertainty of it, is also too gross for Imitation, savouring somewhat of the Rudeness of those former and more barbarous Ages.

Much beyond it was that Experiment of the *Romans*, in the Contrivance of the *Picts* Wall, related by our Learned *Cambden*; this Wall was built by *Severus* in the *North* Part of *England*, above a hundred Miles long. The Towers of it were about a Mile distant from one another. Betwixt each of these Towers there passed certain hollow Pipes or Trunks in the Curtains of the Wall, through which the Defendants could presently inform one another of any thing that was necessary, as concerning that Place wherein the Enemy was most likely to assault them, *&c.*

Britan. de Vallo sive the *Picts Wall. p.* 654. *Boter. Geog. l.*2. *& l.*4. where he mentions also another Wall of 8000 Furlongs in *China.*

Since the Wall is ruined, and this Means of swift Advertisement taken away, there are many Inhabitants thereabouts, which hold their Land by a Tenure in *Cornage* (as the Lawyers speak) being bound by blowing of a Horn to discover the Irruption of the Enemy.

There is another Experiment to this Purpose mentioned by *Walchius*, who thinks it possible so to contrive a Trunk or hollow Pipe, that it shall preserve the Voice entirely for certain Hours or Days, so that a Man may send his Words to a Friend instead of his Writing. There being always a certain Space of Intermission, for the Passage of the Voice, betwixt its going into these Cavities, and its coming out; he conceives that if both ends were seasonably stopped, whilst the Sound was in the midst, it would continue there till it had some vent. *Huic tubo verba nostra insusurremus, & cum probe munitur tabellario committamus,* &c. When the Friend to whom it is sent, shall receive and open it, the Words shall come out distinctly, and in the same Order wherein they were spoken. From

Fabul. 9.

such a Contrivance as this, (saith the same Author) did *Albertus Magnus* make his Image, and Friar *Bacon* his Brazen Head, to utter certain Words. Which Conceit (if it have any Truth) may serve somewhat to extenuate the gross Absurdity of that *Popish* Relick, concerning *Joseph*'s [Hah] or the Noise that he made (as other Carpenters use) in fetching of a Blow; which is said to be preserved yet in a Glass amongst other Ancient Relicks.

But against these Fancies it is considerable, that the Species of Sound are multiplied in the Air, by a kind of Continuation and Efflux from their first Original, as the Species of Light are from any luminous Body; either of which being once separated from their Causes, do presently vanish and die. Now as it would be a mad thing for a Man to endeavour to catch the Sun-beams, or enclose the Light; upon the same Grounds likewise must it needs be absurd, for any one to attempt the shutting in of articulate Sounds: Since both of them have equally the same intrinsical and inseparable Dependance upon their efficient Causes.

True, indeed, the Species of Sound may seem to have some kind of Self-continuance in the Air, as in Ecchoes; but so likewise is it in Proportion with those of Sight, as in the quick turning round of a Fire-stick, which will make the Appearance of a fiery Circle: And tho' the first kind of these be more lasting than the other, by reason their natural Motion is not so quick, yet neither of them are of such Duration as may be sufficient for the present Enquiry.

None of all these Inventions already specified, do sufficiently perform the Business that is here enquired after; nor are they either so generally or safely appliable for all Places and Exigencies.

The Discovery that is here promised, may be further serviceable for such Cases as these.

Suppose a Friend were perfidiously clapped up in some

some close Dungeon, and that we did not know exactly where, but could only guess at the Place, within the Latitude of half a Mile or somewhat more; a Man might very distinctly by these other Inventions, discourse unto him. Or suppose a City were straitly Besieged, and there were either within it or without it, such a Confederate, with whom we should necessarily confer about some Design; we may by these Means safely discover to him our Intentions. By which you may guess that the Messenger which is here employed, is of so strang a Nature, as not to be barred out with Walls, or deterred by Enemies.

To the Performance of this, it is requisite that there be two Bells of different Notes, or some such other audible and loud Sounds, which we may command at Pleasure, as Muskets, Cannons, Horns, Drums, *&c.* By the various Sounding of these (according to the former Table) a Man may easily express any Letter, and so consequently any Sense.

These Tables I shall again repeat in this Place: *Cap. 9.* That of two Letters may be contrived thus:

A.	B.	C.	D.	E.	F.	G.
aaaaa.	aaaab.	aaaba.	aaabb.	aabaa.	aabab.	aabba.

H.	I.	K.	L.	M.	N.	O.
aabbb.	abaaa.	abaab.	ababa.	ababb.	abbaa.	abbab.

P.	Q.	R.	S.	T.	V.	W.
abbba.	abbbb.	baaaa.	baaab.	baaba.	baabb.	babaa.

X.	Y.	Z.
babab.	babba.	babbb.

Suppose the Word *Victuals* were this Way to be expresst; let the bigger Sound be represented by A, and the lesser by B, according to which, the Word may be thus made up by five of these Sounds for each Letter.

V. I. C. T. U. A. L.
baabb. abaaa. aaaba. baaba. baabb. aaaaa. ababa.
S.
baaab.

That is, the lesser Note sounded once, and then the bigger twice, and then again the lesser twice, as (baabb) will signifie the Letter (V.) So the bigger once, and then the lesser once, and after that the bigger thrice together, as (abaaa) will represent the Letter (I.) and so of the rest.

If the Sounds be capable of a triple Difference, then each Letter may be expressed by a threefold Sound, as may appear by this other Alphabet.

A. B. C. D. E. F. G. H. I. K. L.
aaa. aab. aac. baa. bab. bba. bbb. bbc. caa. cba. cbb.

M. N. O. P. Q. R. S. T. V. W. X.
cbc. cca. ccb. ccc. aba. abb. abc. aca. acb. acc. bca.

Y. Z.
bcb. bcc.

V. I. C. T. U. A. L. S.
acb. caa. aac. aca. acb. aaa. cbb. abc.

If these Sounds do contain a quintuple difference, then may every Letter be signified by two Sounds only, (which will much conduce to the Speed and Dispatch of such a Message.) As you may see in this other Table.

A. B. C. D. E. F. G. H. I. K. L. M. N. O. P.
aa. ab. ac. ad. ae. ba. bb. bc. bd. be. ca. cb. cc. cd. ce.

Q. R. S. T. V. W. X. Y. Z.
da. db. dc. dd. de. ea. eb. ec. ed.

V. I. C. T. U. A. L. S.
de. bd. ac. dd. de. aa. ca. dc.

'Tis related by *Porta*, that when the Citizens in the Siege of *Navarre* were reduced to such great Extremities that they were ready to yield, they did discover to their Friends the Greatness and Kind of their Wants, by discharging divers Cannons and Ordnances in the Night-time, according to a certain Order before agreed upon; and by this Means did obtain such fitting Supplies as preserved the City. *De furt. lit. l. 1. c. 6.*

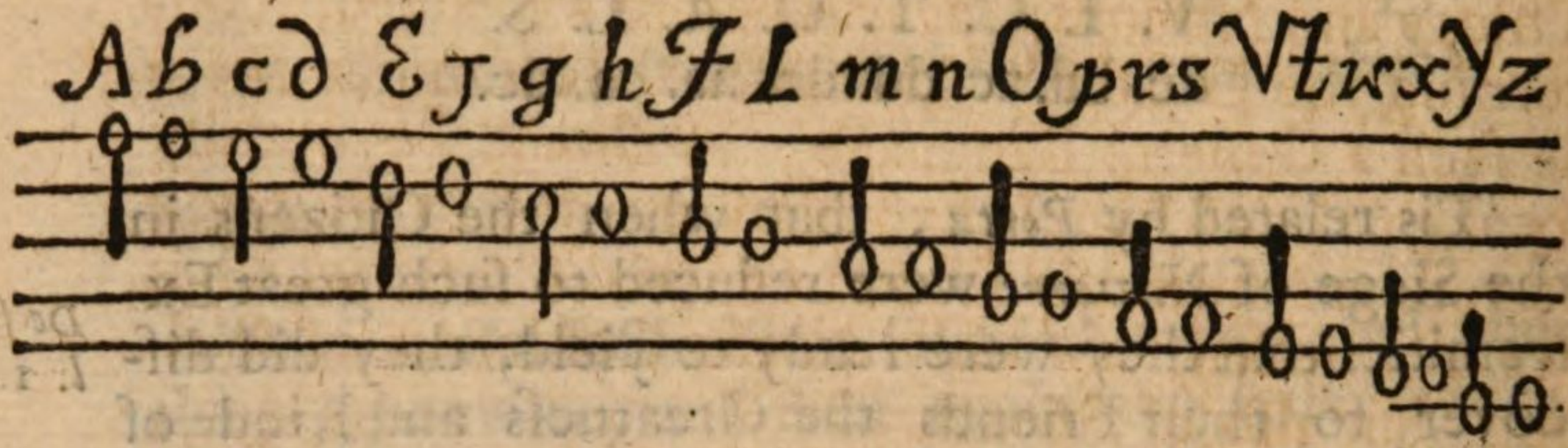
CHAP. XVIII.

Concerning a Language that may consist only of Tunes and Musical Notes, without any articulate Sound.

IF the Musical Instrument that is used to this Purpose, be able to express the Ordinary Notes, not only according to their different *Tones*, but their *Times* also, then may each Letter of the Alphabet be rendred by a single Sound.

Whence it will follow, that a Man may frame a Language, consisting only of Tunes and such inarticulate Sounds, as no Letters can express. Which kind of Speech is fancied to be usual amongst the Lunary Inhabitants, who (as * *Domingo Gonsales* hath discovered) have contrived the Letters of the Alphabet upon the Notes after some such Order as this.

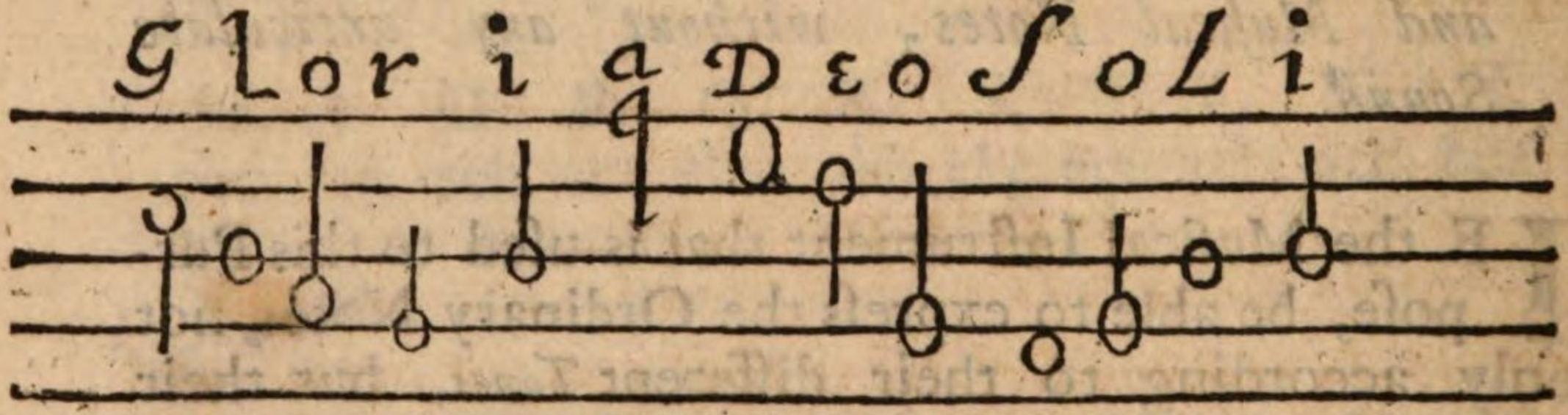
* Or the Man in the Moon, written by the same Author of *Nuntius Inanimat.*



Where the 5 Vowels are represented by the Minnums on each of the five Lines, being most of them placed according to their right Order and Consequence, only the Letters K. and Q. are left out, because they may be otherwise expressed.

See *Dom. Gonsal* 94.

According to this Alphabet of Notes, these Words, *Gloria Deo soli*, must be thus contrived.



By this you may easily discern how two Musicians may discourse with one another, by playing upon their Instruments of *Musick*, as well as by talking with their Instruments of *Speech*. And (which is a singular Curiosity) how the Words of a Song may be contrived in the Tune of it.

I suppose that these Letters and Notes might be disposed to answer one another, with better Advantage than here they are expressed. And this perhaps, would be easie enough for those that are thoroughly versed in the Grounds of Musick, unto whose further Enquiry I do here only propose this Invention.

But now if these inarticulate Sounds be contrived

for

for the Expreſſion, not of Words and Letters, but of Things and Notions, (as was before explained, concerning the Univerſal Character) then might there be ſuch a General Language, as ſhould be equally ſpeakable by all People and Nations; and ſo we might be reſtored from the ſecond General Curſe, which is yet manifeſted, not only in the Confuſion of Writing, but alſo of Speech.

The Utterance of theſe Muſical Tunes may ſerve for the Univerſal *Language*, and the Writing of them for the Univerſal *Character*. As all Nations do agree in the ſame Conceit of Things, ſo likewiſe in the ſame Conceit of Harmonies.

This Curioſity (for ought I know) has not yet been mentioned by any Author, but it may be (if well conſidered) of ſuch excellent Uſe, as to deſerve a more full and particular Enlargement in a Treatiſe by it ſelf.

CHAP. XIX.

Of thoſe common Relations that concern Secret and Swift Informations by the Species of Sight; which are either Fabulous, *or* Magical.

THE uſual Relations that concern Secret and Swift Conveyances by the Species of Sight, may be diſtinguiſhed into ſuch as are, either

1. *Fabulous.*
2. *Magical.*
3. *Natural and true.*

1. Of thoſe fabulous Relations to this purpoſe.

Firſt, Of thoſe that are *Fabulous*. In which kind, that of the Loadſtone is moſt remarkable, as it is maintained by * *Famianus Strada*, in his Imitation of *Lucretius*'s Stile, and divers others. The Manner that is uſually preſcribed for the Performance of it, is

* *Lib.* 2. *Prol.* 6.

is thus: Let there be two Needles provided, of an equal Length and Bigness, being both of them touched with the same Loadstone: Let the Letters of the Alphabet be placed in the Circles on which they are moved, as the Points of the Compass under the Needle of the Mariner's Chart. Let the Friend that is to travel take one of them with him, first agreeing upon the Days and Hours wherein they should confer together: At which times, if one of them move the Needle of his Instrument to any Letter of the Alphabet, the other Needle, by a Sympathy, will move unto the same Letter in the other Instrument, though they be never so far distant: And thus by several Motions of the Needle to the Letters, they may easily make up any Words or Sense which they have a mind to express.

O utinam hæc ratio scribendi prodeat usu;
Cautior & citior properaret Epistola, nullas
Latronum verita insidias, fluviosque morantes,
Ipse suis princeps manibus sibi conficeret rem, &c.

Saith *Strada*. But this Invention is altogether imaginary, having no Foundation in any real Experiment. You may see it frequently confuted in those that treat concerning Magnetical Virtues. *Non solum exhibilandi sunt, sed etiam male mulctandi Philosophicâ ferulâ, fabularum isti procusores, qui suis portentis deterrent homines à præclarissimo causarum studio*; saith *Cabæus* to this purpose.

Philosoph. Magnet. l. 4. c. 10.

The first Occasion of these Relations, was, the Proof of that strange immaterial Power of the Loadstone, whereby it did work through thick and solid Bodies, as a Table, or Wall, or the like; as also of that directive Virtue, whereby it always tends to the Poles; from whence others have conjectured, that it might be serviceable also for such a Business, at so great a Distance.

But against this, it is considerable,

1. That

1. That every Natural Agent is supposed to have some certain Sphere, which determines its Activity.

2. That Magnetical Operations do not arise (as some fondly conceive) from a Sympathetical Conformation of Natures, which is the same at all distances; but from such a Diffusion of these Magnetical Qualities through the *Medium*, that they may be continued from the Agent to the Patient. And so these Natural Powers will not be of so great an Extent, as they are supposed in this Experiment.

The utmost Distance, at which we may discourse with another by these Magnetical Virtues, is, two or three Foot, or thereabouts; and this we may do, tho' it be through a Wall of that Thickness. *Fieri enim posse me docuit experientia, ut ope Magnetis, & instrumenti ad id aptati, amicus cum amico, in cubiculo proximo, trans crassum murum (puta bipetalem) colloquatur, animi sui sententiam impertiat, & ad quæsita respondeat*; saith a late Author. But in this Experiment, it is not only the secondary Virtue of the Needles that can be thus effectual, (as is supposed in the former Invention) but there must be the Help also of the Loadstone it self. *S. Ward Magnetis Reduct. c. 40. See Cabæus Phil. Magn. l. 4. c. 11.*

As for the Reason why these Magnetical Powers are able to work through Solid Bodies; 'tis considerable, that any Quality may be diffused through such a Substance, as hath no Natural Repugnancy unto it. We see, the Light does pass as well through hot Bodies as cold, through solid as fluid, *&c.* only Opacity keeps it out, because that Quality alone is contrary to its Nature. So likewise is it with Magnetical Virtues, which do equally spread themselves through all kind of Bodies, whether *rare* or *dense*, *diaphanous* or *opacous*; there being no Quality contrary to this, because it is that General Endowment of the whole Globe, that Universal Quality to which all other Particulars are naturally subservient.

The

2. Magical.

The second Sort of Relations to this purpose, are such as refer to *Diabolical Magick*; of which kind is that Invention thought to be, which is commonly ascribed to *Pythagoras*; of whom it is reported, that he could write any thing in the Body of the Moon, so as it might be legible to another at a great Distance. *Agrippa* affirms this to be naturally possible, and the way of performing it not unknown to himself, with some others in his time: And *Fredericus Risner* seems to believe it; for speaking of the strange Experiments to be wrought by some Glasses, he adds, *Denique certo artificio, depictas imagines, aut scriptas literas, nocte serena, plenæ lunæ sic opponi possunt, ut radiis lunam irradiantibus, ideoque reflexis, videas & legas, quæ Constantinopoli Lutetiam tibi nuncientur.*

Occult. Philosoph. l. 1. c. 6.

Optic. l. 3. prop. 36. Speculorum persuasio hoc pervasit, &c.

There is an Experiment in Opticks, to represent any Writing by the Sun-beams, upon a Wall, or Front of a House: For which purpose, the Letters must be first described with Wax, or some other opacous Colour, upon the Surface of the Glass, in an inverted Form; which Glass afterwards reflecting the Light upon any Wall in the Shade, will discover these Letters in the right Form and Order. Unto some such Invention I did first (before I had well consider'd these particulars) attribute the Performance of those strange Promises in *Nuncius Inanimatus*; but upon better Thoughts it will be found, that the Species of Reflection in this Experiment are so weak, that unless the Glass and the Letters be very big, and the Wall somewhat near, there will be no distinct Appearance of the Writing. And therefore this way there can be no Thoughts of contriving any reflected Species, that shall be visible at so great a Distance as the Moon. Nor is there any other Natural Means conceivable, by which so strange an Effect may be performed; which is the Reason that it is so frequently attributed to

World in the Moon, c. 7.

Diabo-

Diabolical Magick, by almost all the Writers that have occasion to treat of it.

But *Agrippa* in another place speaking concerning this Invention, affirms that it was performed thus: *Pythagoras* did first describe with Blood any Letters which he thought fit, in some great Glass, and then opposing the Glass against the Full Moon, the Letters would appear thorough it, as if they were writ in the circumference of her Body. *Quæ collibuisset sanguine perscripsit in speculo, quo, ad pleni luminis lunæ orbem obverso, stanti à tergo, res exaratas in disco lunæ commonstravit.* In which Passage he seems to intimate, that this Writing in the Moon could not be visible at any great distance (as it is related in common Tradition), but that it did appear to such only, betwixt whose Eyes and the Moon this Glass might be interposed. And according to this, the Wonder of the Relation ceases, nor may it truly be referred to Diabolical Magick.

Agrippa de Vanit. Scient. c. 48.

More properly reducible to this kind, are those inchanted Glasses mentioned in divers Authors: In which some Magicians are said to contain such familiar Spirits, as do inform them of any Business they shall enquire after. I have heard a great Pretender to the knowledge of all secret Arts, confidently affirm, that he himself was able at that time, or any other, to shew me in a Glass what was done in any part of the World; what Ships were sailing in the *Mediterranean*; who were walking in any Street of any City in *Spain*, or the like. And this he did aver with all the labour'd Expressions of a strong Confidence. The Man, for his Condition, was an *Italian* Doctor of Physick; for his Parts, he was known to be of extraordinary Skill in the abstruser Arts, but not altogether free from the Suspicion of this unlawful Magick.

Joach. Camerar. Præm. in lib. Plut. de defect. Orac.

CHAP.

CHAP. XX.

Of Informations by significatory Fires and Smoaks. Their Antiquity. The true manner of using them to this purpose. That these were meant in Nuntius inanimatus.

THE Experiments of this kind that are true, and upon Natural Grounds, have been made either by Fire in the Night, or Smoak and such other Signs visible at a distance in the Day-time.

These Informations by significatory Fires, have been of Ancient Use. The first Invention of them is commonly ascribed to *Sinon* in the *Trojan* Wars. *Speculatorem significationem Trojano Bello Sinon invenit*, (saith *Pliny*.) This was the Sign upon which he agreed to unlock the Wooden Horse.

Nat. Hist. l. 7. c. 56.

Virgil.

——— *Flammas cum regia puppis*
Extulerat. ———

But *Diodorus Siculus* affirms them to be practised by *Medea* in her Conspiracy with *Jason*. And they are frequently mentioned in other Ancient Historians. * *Herodotus* speaks of them in the *Grecian* War against *Xerxes*: And † *Thucydides* testifies of them in the Onsets that were made by the *Peloponnesians* against *Salamis*, and in the Siege of *Corcyra*. *Appian* speaking of *Scipio* at *Numantia*, how he divided his Camp into divers Companies, says, That he assigned each of them to several Tribunes, with this Charge, *Si impeterentur ab hoste, de die*, * *panno rubro in hasta sublato significarent*; *de nocte*, *igne*. If the Enemy did charge any of them, they should signify it to the others, in the Day-time by holding up a Red Cloth, in the Night by Fires. ‡ *Vegetius* affirms it to be usual, when the Army was divided, to inform one another, in the Day by Smoak, in the Night by

Biblioth. l. 4.

* *Polymn. l. 7. c. 182.*
† *Hist. l. 2. Item, l. 3.*
So *Curtius* of *Alex M. l. 5.*
* To this purpose the Flags of Truce or Defiance.
‡ *De re milit. l. 3. c. 5. Lypsius de milit. Rom.*

by Fires. These significatory Fires were by the *Grecians* called Φρύκτοι (saith *Suidas*) and sometimes Πυρσεια. The Use of them was chiefly for the Answer of some particular *Quære*, that was before agreed upon; as concerning the coming of Aids or Enemies; if the Enemies were coming, they were wont to shake these Torches, if the Aids, they held them still, (saith the *Scholiast* upon *Thucydides.*)

Æneas Poliorc. c.31.

Schol. in l.2.Thucyd.

But they have by more exact Inventions been enlarged to a greater Latitude of Signification: So that now, any thing which we have Occasion to discover, may be expressed by them.

Wecker de Secretis, l. 14. c. 1. Port. de furt. lit. l. 1. c. 10. Cardan. de Variet. Rerum, l. 12. c. 61.

The Ways by which they may be contrived to this purpose, are divers; I shall specify only the chief of them.

That which in ancient Times was used by the *Grecians*, and is particularly treated of in * *Polybius*, adviseth thus:

Hist. l. 10. juxta fin.

Let the Letters be divided into Five Tablets or Columns.

By Ten Torches.

	I	II	III	IV	V
	—	—	—	—	—
1	*a*	*f*	*l*	*q*	*w*
	—	—	—	—	—
2	*b*	*g*	*m*	*r*	*x*
	—	—	—	—	—
3	*c*	*h*	*n*	*s*	*y*
	—	—	—	—	—
4	*d*	*i*	*o*	*t*	*z*
	—	—	—	—	—
5	*e*	*k*	*p*	*u*	
	—	—	—	—	—

Let there be provided Ten Torches, Five being placed on the Right Hand, and Five on the Left: Let so many Torches be lifted up on the Right Hand, as may shew the number of the Table; and so many on the Left, as may shew the number of that Letter

Letter in it which you would expreſs: As in this following Example, wherein the ſeveral Numbers, both at the Right and Left Hand, do ſignify the word H A S T E N.

The Right Hand.		The Left Hand.
II	H	3
I	A	1
IV	S	3
IV	T	4
I	E	5
III	N	3

That is, Two Lights being lifted up on the Right Hand, ſhew the ſecond Column; and at the ſame time Three Torches appearing on the Left Hand, denotes the Third Letter in that Column, which is *H*. Thus a ſingle Torch being diſcovered on both ſides, doth ſignify the firſt Letter of the firſt Column, which is *A*; and ſo of the reſt.

By three Torches. *Lib. de Experiment.*

There is another way mentioned by *Joachimus Fortius*, unto the performance of which there are only Three Lights required: One Torch being ſhewed alone, ſhall ſignify the Eight firſt Letters, *A. B. C. D. E. F. G. H.* Two together, the Eight next, *I. K. L. M. N. O. P. Q.* And all Three the reſt, *R. S. T. V. W. X. Y. Z.*

One Light being diſcovered once, ſignifies *A*; if twice, *B*: Two Lights being ſhewed once, do denote the Letter *I*; if twice, *K*, &c.

According

According to this way, if I would expreſs the word FAMIN, the Torches muſt be contrived; one Light muſt be lifted up ſix times for the Letter *F*; one Light once for *A*; two Lights four times for *M*; two Lights once for *I*; two Lights five times for *N*.

But here it will be requiſite that there be ſome intermiſſion betwixt the expreſſion of ſeveral Letters, becauſe otherwiſe there muſt needs be a great confuſion amongſt thoſe that belong to the ſame number of Torches. In which reſpect, this way is much more tedious and inconvenient than the former Invention out of *Polybius*.

By two Torches.

It is eaſie to conceive, how by the Alphabet conſiſting of two Letters tranſpoſed through five Places, ſuch a Manner of Diſcourſing may be otherwiſe contrived, only by two Torches. But then there muſt be five Shews, to expreſs every Letter.

There is another way of Speaking, by the Differences of Motion in two Lights; which for its Quickneſs and Speed, is much to be preferred before any of the reſt; the manner of it is thus: Provide two Torches on long Poles: Let them be placed ſo far from one another, that they may ſeem unto your Confederate to be about four Cubits diſtance. By the divers Elevations or Depreſſions of theſe, inclining of them to the Right Hand, or to the Left, ſeverally or both together, it is eaſie to expreſs all the Alphabet.

One Light alone being diſcovered, muſt ſtand for *A*; lifted up, for *E*; depreſſed, for *I*; inclined to the Right Hand, for *O*; unto the Left Hand, for *K*.

Two Lights elevated, for *B*; depreſſed, for *C*; inclined to the Right Hand, for *D*; to the Left Hand, for *F*.

Two Lights being ſtill diſcovered, and the Torch at the Right Hand being lifted up, ſhall ſignifie *G*;

being

being depressed, *H*; inclined to the Right Hand, *K*; to the Left Hand, *L*.

The Torch at the Left Hand, being elevated, shall stand for *M*; depressed, for *N*; inclined to the Right Hand, for *P*; to the Left Hand, for *Q*.

The Torch at the Right Hand being moved towards the Left Hand, and that at the Left Hand being at the same time moved towards the Right Hand, shall signifie *R*: The Right Hand Torch being inclined to the Left Hand, and the other at the same time being elevated, signifies *S*; being depressed, *T*: The Left Hand Torch being inclined to the Right Hand, and the other at the same time being elevated, signifies *W*; being depressed, *X*.

The Right Hand Torch being inclined to the Right Hand, and the other at the same time being elevated, may stand for *Y*; being depressed, for *Z*.

When any thing is thus to be expressed, the two Torches being discovered, must remain without any Motion, so long, till the Confederate shall by other Lights shew some Sign, that he is ready to take notice. After every one of these particular Motions, the Torches must be carefully hidden and obscured, that so the several Letters expressed by them, may be the better distinguished.

The day-time Informations by Smoak, cannot so conveniently be ordered according to this latter Contrivance, and therefore must be managed by some of those other Ways that were specified before: To which purpose there must be some Tunnels provided, for the orderly incloſing and conveying up the Smoak. The other particulars concerning this, are in themselves easie enough to be apprehended.

How these significatory Signs will be visible at a great Distance. How by Multiplication of them in several Places, they may be contrived for many Scores of Miles, will easily be discerned from the Situation and Use of Beacons, by which the Intima-

See *Barcla. Argen. l.* 1.

tion

tions of Publick Danger and Preparations, have been oftentimes suddenly spread over this whole Island.

This may further be advantaged by the Use of *Galilæus* his Perspective.

'Tis storied of the Inhabitants in *China*, that when any Merchants do happen upon the Shores of that Kingdom, they are presently examined, whence they come, what Commodities they bring, and of what Number they are: Which being known, the Watch (set for that purpose) do presently inform the King of their Answers, by Smoak in the Day, and Fires in the Night: Who by the same Means does as speedily return them his Pleasure, whether they shall be admitted or kept out: And so that is easily dispatched in some few Hours, which could not be performed the ordinary Way, without the Trouble of many Days. *Busbequius Epist. Tur. ep. 4.*

The Practice of all these secret and swift Messages, may perhaps seem very difficult at the first; but so does also the Art of Writing and Reading to an unlettered Man: Custom and Experience will make the one as facile and ready as the other. *Polyb. l. 10.*

That these ways of Information already explained, whether by the Species of *Sound* or *Sight*, are the same with those intimated in *Nuntius Inanimatus*, may be clearly evident to any one who does but thoroughly peruse that Discourse, and compare it with divers other the like Passages of the same Author, in his *Domingo Gonsales*.

1. For the Species of Sound, his Words are these, *Auribus nihil percipi nisi personum, neminem fugit. Erit igitur necesse ut is, cui aliquid auditu mediante nunciatum fuerit, sonos audiat, eosque distinguibiles pro numero audiendorum; quæ cum sint infinita, infinita, etiam sit oportet, sonorum edendorum varietas. Satis tamen erit ut distinguantur vel genere, vel tempore, modo etiam & numero.* Which Passage, together with that other Invention in *Domingo Gonsales*, concerning the Lan- *Nunc. Inanim.* p. 167

guage of the Lunary Inhabitants, before explained in the eighteenth Chapter; I say, both these, being compared with the Discoveries and Experiments of the same kind that are here discoursed of, may plainly manifest, that they are both performed by the same Means.

2. For the Species of Sight, his words are these, *Si oculis amici absentis aliquid cupis representare, idque citius quam corpus aliquod sublunare ad locum tam longo intervallo disjunctum possit perferri; oportet ut ideæ, sive formæ visibiles, augeantur, quantitate, multiplicentur numero, & pro rerum significandarum varietate varientur, vel qualitate, vel quantitate, vel situ, vel ordine.* Which Passage being compared with that other way of Compact, betwixt *Gonsales* and his Man *Diego*, mentioned in the other Discourse; it may evidently appear, that the Ways of Intimation which were there meant, are performed after the same Manner, according to which they are here discoursed of.

Nunc. Inani. p. 16.

Man in the Moon, *p.* 21.

He does indeed mention out of *Busbequius*, the Practice of those Informations amongst the Inhabitants of *China*, and thinks that they were used too by the *Romans*; but withal he wonders how that now amongst us, they should be altogether forgotten; and the restoring of them to these Places and Times, seems to be his chief Aim, in the Promises of that Discourse.

The particular Example which he mentions, is this: Suppose that one at *London* would send a Message to *Bristol*, *Wells*, *Exeter*, or though it were any remoter Place: *Neq; enim longinquitatem viæ multum moror, si detur facultas sternendi, & permeabilem efficiendi.* That is, the Greatness of Distance can be no Impediment, if the Space betwixt be fitted with such high Mountains, and Beacon Hills, as may serve for these kind of Discoveries. Suppose (I say) this Messenger should set forth from *London*, in the very point of Noon, he would notwithstanding arrive

rive at *Bristol* before Twelve of the Clock that Day: That is, a Message may by these means be conveyed so great a distance, in fewer Minutes than those which make the Differecce betwixt the two Meridians of those Places.

If according to this, we should interpret that Passage out of *Trithemius*, concerning the three *Saturnine* Angels, that in Twenty four Hours can convey News from any part of the World; that Author might then in one respect, be freed from the Aspersion of Diabolical Magick, which for this very Reason hath heretofore been imputed to him. But this by the Way. See before *Cap.* 15.

It may be, the Resolution of those great Promises in *Nuncius Inanimatus*, to such easie Causes as they are here ascribed unto, will not be answerable to Men's Expectation; every one will be apt to mistrust some greater matter than is here expresst: But 'tis thus also in every other the like Particular; for Ignorance is the Mother of Wonder, and Wonder does usually create unto it self many wild Imaginations; which is the Reason why Men's Fancies are so prone to attribute all unusual and unknown Events, unto stranger Causes than either Nature or Art hath designed for them.

CONCLUSION.

THE Poets have feigned *Mercury* to be the chief Patron of Thieves and Treachery, *Horat. l. 1. Od. 10. Ovid. Metam. l. 11. Homer. in Hymnis. Nat. Comes Mytholog. l. 5. c. 5.*

Ἀρχὸς φηλητέων.

To which purpose they relate that he filched from *Venus* her Girdle, as She embraced him in Congratulation of a Victory; that he robbed *Jupiter* of his Scepter, and would have stoln his Thunderbolt too,

but that he feared to burn his Fingers. And the Astrologers observe, that those who are born under this Planet, are naturally addicted to Theft and Cheating.

If it be feared that this Discourse may unhappily advantage others in such unlawful Courses; 'tis considerable, that it does not only teach how to deceive, but consequently also how to discover Delusions. And then besides, the chief Experiments are of such Nature, that they cannot be frequently practised, without just Cause of Suspicion, when as it is in the Magistrates Power to prevent them. However, it will not follow, that every thing must be suppreſt which may be abused. There is nothing hath more occasioned Troubles and Contention, than the Art of Writing, which is the Reason why the Inventor of it is fabled to have sown Serpents Teeth: And yet it was but a barbarous Act of *Thamus*, the *Egyptian* King, therefore to forbid the Learning of Letters: We may as well cut out our Tongues, because that Member is *a world of wickedness*. If all those useful Inventions that are liable to abuse, should therefore be concealed, there is not any Art or Science which might be lawfully profest.

Cali. Rho. antiq. Lect. l. 22. c. 15.

James 3.

F I N I S.

MATHEMATICAL
MAGICK:
OR THE
WONDERS

That may be perform'd by

Mechanical Geometry.

In Two Books.

Concerning

Mechanical { POWERS. / MOTIONS.

Being one of the moſt Eaſy, Pleaſant, Uſeful (and yet moſt Neglected) Part of the *Mathematicks.*

Not before treated of in this Language.

The Fifth Edition.

By the Right Reverend Father in God, *JOHN WILKINS*, late Lord Biſhop of *CHESTER.*

Τεχνῃ κρατοῦμεν ὧν φύσει νικώμεθα.

LONDON:

Printed for *John Nicholſon* at the *King's-Arms* in *Little Britain*; *Benj. Tooke* at the *Middle Temple Gate* in *Fleetſtreet*; *And. Bell* at the *Croſs Keys and Bible* in *Cornhill*; and *Ralph Smith* under the *Piazza* of the *Royal-Exchange.* MDCCVII.

MATHEMATICAL

MAGICK:

OR THE

WONDERS

That may be performed by

Mechanical {POWERS, MOTIONS,

Being one of the most Ingenious, Useful (and Yet Much Neglected) Parts of the Mathematicks.

In Two Books.

Containing

I. Whatever is Treated of in this Large Edition

The Fifth Edition.

By the Right Reverend Father in God,
JOHN WILKINS, late Lord
Bishop of CHESTER.

LONDON:

Printed for John Nicholson at the King's-Arms in Little Britain; Benj. Tooke at the Middle Temple Gate in Fleet-street; and Ralph Smith under the Piazza of the Royal-Exchange. MDCCVII.

To His Highneſs the
Prince Elector PALATINE.

May it pleaſe Your Highneſs,

I *Should not thus have preſented my* Diverſions *where I owe my Study and* Buſineſs, *but that where All is due, a Man may not juſtly withhold any Part.*

This following Diſcourſe was compoſed ſome Years ſince, at my ſpare Hours in the Univerſity. The Subject of it is mixed Mathematicks; *which I did the rather at ſuch Times make choice of, as being for the* Pleaſure *of it more proper for Recreation, and for the* Facility, *more ſuitable to my Abilities and Leiſure.*

I ſhould not, Sir, have been ambitious of any ſo Great (*I could not of any* Better) *Patronage, had not my Relation both engaged and emboldened me to this Dedication.*

They that know Your Highneſs, how great an Encourager You are, and how able a Judge in all Kind of Ingenious Arts and Literature, muſt needs acknowledge Your Preſſures and Low Condition to be none of the leaſt Miſchiefs (amongſt thoſe many other) under which the Commonwealth of Learning does now ſuffer.

It would in many Reſpects much conduce to the general Advancement of Religion and Learning, if the Reformed Churches, in whoſe Cauſe and Defence Your Family hath ſo deeply ſuffer'd, were but effectually mindful of their Engagements to it. And particularly, if theſe preſent Unhappy Differences of this Nation, did not occaſion too much Forgetfulneſs of their former Zeal and Profeſſions for the Vindicating *of Your Family, and the* Reſtoring *of Your Highneſs: The Haſtening and Accompliſhment of which, together with the Increaſe of all Heavenly Bleſſings upon Your Highneſs, ſhall be the hearty daily Prayer of,*

Your Highneſs's
moſt Humble and moſt Devoted
Servant and Chaplain,
John Wilkins.

To the Reader.

IT is related of *Heraclitus*, That when his Scholars had found him in a Tradeſman's Shop, whither they were aſhamed to enter; he told them, *Quod neque tali loco dii deſunt immortales*; That the gods were as well converſant in ſuch Places, as in others: Intimating, that a Divine Power and Wiſdom might be diſcerned, even in thoſe common Arts which are ſo much deſpiſed: And tho' the Manual Exerciſe and Practice of them be eſteemed ignoble, yet the Study of their General Cauſes and Principles, cannot be prejudicial to any other (tho' the moſt ſacred) Profeſſion.

It hath been my uſual Cuſtom in the Courſe of my other Studies, to propoſe divers Mathematical or Philoſophical Enquiries, for the Recreation of my Leiſure Hours; and as I could gather Satisfaction, to compoſe them into ſome Form and Method.

Some of theſe have been formerly publiſhed, and I have now ventured forth this Diſcourſe; wherein, beſides the great *Delight and Pleaſure*, (which every Rational Reader muſt needs find in ſuch Notions as carry with them their own Evidence and Demonſtration) there is alſo much *real Benefit* to be learned; particularly for ſuch Gentlemen as employ their Eſtates in thoſe chargeable Adventures of Draining Mines, Coalpits, *&c.* who may from hence learn the chief Grounds and Nature of Engines, and thereby more eaſily avoid the Deluſions of any cheating Impoſtor; And alſo for ſuch *common Artificers*, as are well skill'd in the *Practice* of theſe Arts, who may be much advantaged by the right Underſtanding of their Grounds and *Theory*.

Ramus

To the READER.

Ramus hath obſerved, That the Reaſon why *Germany* hath been ſo Eminent for Mechanical Inventions, is, becauſe there have been publick Lectures of this kind inſtituted amongſt them; and thoſe, not only in the Learned Languages, but alſo in the vulgar Tongue, for the Capacity of every Unlettered Ingenious Artificer. *Schol. Mathem. l. 2.*

This whole Diſcourſe I call *Mathematical Magick*; becauſe the Art of ſuch Mechanical Inventions as are here chiefly inſiſted upon, hath been formerly ſo ſtiled; and in Alluſion to vulgar Opinion, which doth commonly attribute all ſuch ſtrange Operations unto the Power of Magick: For which Reaſon the Ancients did name this Art, Θαυμαποιητικὴ, or *Mirandorum Effectrix*. *Agrippæ, de Vanit. Scient. c. 42.*

The Firſt Book is called *Archimedes*, becauſe he was the chiefeſt in diſcovering of Mechanical *Powers*.

The Second is ſtiled by the Name of *Dædalus*, who is related to be one of the firſt and moſt famous amongſt the Ancients, for his Skill in making *Automata*, or ſelf-moving Engines: Both theſe being two of the firſt Authors, that did reduce Mathematical Principles unto Mechanical Experiments.

Other Diſcourſes of this kind, are for the moſt part large and voluminous, of great Price, and hardly gotten; and beſides, there are not any of them (that I know of) in our Vulgar Tongue, for which theſe Mechanical Arts of all other are moſt proper. Theſe Inconveniences are here in ſome meaſure remedied; together with the Addition (if I miſtake not) of divers Things very conſiderable, and not inſiſted upon by others.

THE

THE
CONTENTS and METHOD
Of this following Diſcourſe.

The Firſt Book.

Chap I. *THE Excellency of theſe Arts. Why they were concealed by the Ancients. The Authors that have treated of them.*

Chap. II. *Concerning the Name of this Art. That it may properly be ſtiled Liberal. The Subject and Nature of it.*

Chap. III. *Of the firſt Mechanical Faculty, the* Balance.

Chap. IV. *Concerning the ſecond Mechanick Faculty, the* Leaver.

Chap. V. *How the Natural Motion of Living Creatures is conformable to theſe Artificial Rules.*

Chap. VI. *Concerning the* Wheel.

Chap. VII. *Concerning the* Pulley.

Chap. VIII. *Of the* Wedge.

Chap. IX. *Of the* Screw.

Chap. X. *An Enquiry into the magnificent Works of the Ancients, which much exceeding our later Times, may ſeem to infer a Decay in theſe Mechanical Arts.*

Chap. XI. *That the Ancients had divers* Motives *and* Means *for ſuch vaſt magnificent Works, which we have not.*

Chap. XII. *Concerning the Force of the Mechanick Faculties; particularly the* Balance *and* Leaver: *How they may be contrived to move the whole World, or any other conceivable Weight.*

Chap. XIII,

The CONTENTS.

Chap. XIII. Of *the* Wheel, *by Multiplication of which, it is eaſy to move any imaginable Weight.*

Chap. XIV. *Concerning the infinite Strength of* Wheels, Pulleys, *and* Screws; *that it is poſſible by the Multiplication of theſe, to pull up any* Oak *by the Roots with a Hair, lift it up with a Straw, or blow it up with ones Breath; or to perform the greateſt Labour with the leaſt Power.*

Chap. XV. *Concerning the Proportion of Slowneſs, and Swiftneſs, in Mechanical Motions.*

Chap. XVI. *That it is poſſible to contrive ſuch an Artificial Motion, as ſhall be of a Slowneſs proportionable to the Swiftneſs of the Heavens.*

Chap. XVII. Of *Swiftneſs: How it may be increaſed to any kind of Proportion. Concerning the great Force of* Archimedes *his Engines. Of the* Balliſta.

Chap. XVIII. *Concerning the* Catapultæ, *or Engines for Arrows.*

Chap. XIX. *A Compariſon betwixt theſe Ancient Engines, and the Gunpowder Inſtruments now in Uſe.*

Chap. XX. *That it is poſſible to contrive ſuch an Artificial Motion, as may be equally ſwift with the ſuppoſed Motion of the Heavens.*

The Second Book.

Chap. I. THE *divers Kinds of* Automata, *or Self-movers. Of Mills. Of the Contrivance of ſeveral Motions by rarify'd Air. A brief Digreſſion concerning Wind-guns.*

Chap. II. Of *a Sailing Chariot, that may without Horſes be driven on the Land by the Wind, as Ships are on the Sea.*

Chap. III. *Concerning the fixed* Automata, *Clocks, Spheres repreſenting the Heavenly Motions. The ſeveral Excellencies that are moſt commendable in ſuch kind of Contrivances.*

The CONTENTS.

Chap. IV. *Of the Moveable and Gradient* Automata, *representing the Motions of Living Creatures, various Sounds of Birds, or Beasts, and some of them articulate.*

Chap. V. *Concerning the Possibility of framing an Ark for Submarine Navigations. The Difficulties and Conveniences of such a Contrivance.*

Chap. VI. *Of the Volant* Automata; Archytas *his Dove, and* Regiomontanus *his Eagle. The Possibility and great Usefulness of such Inventions.*

Chap. VII. *Concerning the Art of flying. The several Ways whereby this hath been, or may be attempted.*

Chap. VIII. *A Resolution of the Two chief Difficulties that seem to oppose the Possibility of a flying* Chariot.

Chap. IX. *Of a perpetual Motion. The seeming Facility, and real Difficulty of any such Contrivance. The several Ways whereby it hath been attempted; particularly by Chymistry.*

Chap. X. *Of subterraneous Lamps. Divers Historical Relations concerning their Duration for many Hundred Years together.*

Chap. XI. *Several Opinions concerning the Nature and Reason of these perpetual Lamps.*

Chap. XII. *The most probable Conjecture how these Lamps were framed.*

Chap. XIII. *Concerning several Attempts of contriving a perpetual Motion by Magnetical Virtues.*

Chap. XIV. *The seeming Probability of effecting a continual Motion by Solid Weights, in a hollow Wheel or Sphere.*

Chap. XV. *Of composing a perpetual Motion by fluid Weights.* Concerning Archimedes *his Water-Screw. The great Probability of accomplishing this Enquiry by the Help of that, with the Fallibleness of it upon Experiment.*

ARCHI-

ARCHIMEDES,

OR,

MECHANICAL POWERS.

The First Book.

CHAP. I.

The Excellency of these Arts. Why they were concealed by the Ancients. The Authors that have treated of them.

ALL those various Studies about which the Sons of Men do busy their Endeavours, may be generally comprised under these Three Kinds.

- Divine.
- Natural.
- Artificial.

To the first of these, is reducible, not only the Speculation of Theological Truths, but also the Practice of those Virtues, which may advantage our Minds in the Enquiry after their proper Happiness. And these Arts alone may truly be styled liberal, *Quæ liberum faciunt hominem, quibus curæ virtus est,* (saith the Divine Stoick) which set a Man at Liberty from his Lusts and Passions. *Sen. Ep. 88.*

To the second may be referred all that Knowledge which concerns the Frame of this great Universe, or the usual Course of Providence in the Government of these created Things.

To the last do belong all those Inventions, whereby

by Nature is any way quickned or advanced in her Defects: These artificial Experiments being (as it were) but so many Essays, whereby Men do naturally attempt to restore themselves from the first General Curse inflicted upon their Labours.

This following Discourse does properly appertain to this latter Kind.

Now Art may be said, either to *imitate* Nature, as in Limning and Pictures; or to *help* Nature, as in Medicine; or to *overcome* and *advance* Nature, as in these Mechanical Disciplines, which in this Respect are by so much to be preferred before the other, by how much their End and Power is more excellent. Nor are they therefore to be esteemed less Noble, because more Practical; since our best and most Divine Knowledge is intended for Action; and those may justly be counted barren Studies, which do not conduce to Practice as their proper End.

But so apt are we to contemn every Thing which is common, that the Ancient Philosophers esteemed it a great Part of Wisdom to conceal their Learning from Vulgar Apprehension or Use, thereby the better to maintain it in its due Honour and Respect. And therefore did they generally veil all their Arts and Sciences under such mystical Expressions as might excite the Peoples Wonder and Reverence; fearing lest a more easy and familiar Discovery, might expose them to contempt. *Sic ipsa mysteria fabularum cuniculis operiuntur, summatibus tantum viris, sapientia interprete, veri arcani conscii; Contenti sint reliqui, ad venerationem, figuris defendentibus à vilitate secretum*, saith a Platonick.

Macrobius Somn. Scip. l. 1. c. 2.

Hence was it, that the Ancient Mathematicians did place all their Learning in abstracted Speculations; refusing to debase the Principles of that noble Profession unto Mechanical Experiments. Insomuch, that those very Authors amongst them, who were most eminent for their Inventions of this Kind, and were

were willing by their own Practice to manifeſt unto the World thoſe artificial Wonders that might be wrought by theſe Arts, as *Dædalus*, *Archytas*, *Archimedes*, *&c.* were notwithſtanding ſo much infected with this blind Superſtition, as not to leave any thing in Writing concerning the Grounds and Manner of theſe Operations.

Quintilian ſpeaking to this Purpoſe of *Archimedes*, ſaith thus. *Quam vis tantum tamque ſingularem Geometriæ uſum, Archimedes, ſingularibus exemplis, & admirandis operibus oſtenderit, propter quæ non humanæ ſed divinæ ſcientiæ laudem ſit adeptus, hæſit tamen in illa Platonis perſuaſione, nec ullam Mechanicam literam prodere voluit.* *Quint. l. 1. c. 10.*

By which means, Poſterity hath unhappily loſt, not only the Benefit of thoſe particular Diſcoveries, but alſo the Proficiency of thoſe Arts in General. For when once the Learned Men did forbid the Reducing of them to particular Uſe, and Vulgar Experiment; others did thereupon refuſe theſe Studies themſelves, as being but empty and uſeleſs Speculations. Whence it came to paſs that the Science of Geometry was ſo univerſally neglected, receiving little or no Addition for many Hundred Years together. *Pet. Ram. Schol. Mathem. l. 1.*

Amongſt theſe Ancients, the Divine *Plato* is obſerved to be one of the greateſt Sticklers for this fond Opinion; ſeverely dehorting all his Followers from proſtituting Mathematical Principles, unto common Apprehenſion or Practice. Like the envious Emperor *Tiberius*, who is reported to have killed an Artificer for making Glaſs malleable, fearing leſt thereby the Price of Metals might be debaſed. So he, in his Superſtition to Philoſophy, would rather chuſe to deprive the World of all thoſe uſeful and excellent Inventions which might be thence contrived, than to expoſe that Profeſſion unto the Contempt of the ignorant Vulgar. *Plin. Nat. l. 36. c. 26.*

But

Ariſt. Quæſt. Mechan.

But his Scholar *Ariſtotle*, (as in many other particulars, ſo likewiſe in this) did juſtly oppoſe him, and became himſelf one of the firſt Authors that hath writ any methodical Diſcourſe concerning theſe Arts; chuſing rather a certain and general Benefit, before the hazard that might accrue from the vain and groundleſs Diſrepects of ſome ignorant Perſons. Being ſo far from eſteeming Geometry diſhonoured by the Application of it to Mechanical Practices, that he rather thought it to be thereby adorned, as with curious Variety, and to be exalted unto its natural End. And whereas the Mathematicians of thoſe former Ages, did poſſeſs all their Learning as covetous Men do their Wealth, only in Thought and Notion; the judicious *Ariſtotle*, like a wiſe Steward, did lay it out to particular Uſe and Improvement; rightly preferring the Reality and Subſtance of Publick Benefit, before the Shadows of ſome retired Speculation, or Vulgar Opinion.

Since him there have been divers other Authors who have been eminent for their Writings of this Nature. Such were *Hero Alexandrinus*, *Hero Mechanicus*, *Pappus Alexandrinus*, *Proclus Mathematicus*, *Vitruvius*, *Guidus Ubaldus*, *Henricus Monantholius*, *Galileus*, *Guevara*, *Merſennus*, *Bettinus*, *&c.* Beſides many others that have treated largely of ſeveral Engines, as *Auguſtin Ramelli*, *Vittorio Zoncha*, *Jacobus Beſſonius*, *Vegetius*, *Lipſius*.

Moſt of which Authors I have peruſed, and ſhall willingly acknowledge my ſelf a Debtor to them for many Things in this following Diſcourſe.

CHAP.

CHAP. II.

Concerning the Name of this Art. That it may properly be ſtiled Liberal. The Subject and Nature of it.

THE Word *Mechanick* is thought to be derived ἀπὸ τῦ μήκους καὶ ἄνειν, *multum aſcendere, pertingere*: Intimating the Efficacy and Force of ſuch Inventions. Or elſe παρὰ μὴ χαίνειν, (ſaith *Euſtathius*) *quia hiſcere non ſinit*, becauſe theſe Arts are ſo full of pleaſant Variety, that they admit not either of Sloth or Wearineſs.

Lypſius. Poliorcet. 1. 2. Dial. 3. That's a ſenſeleſs abſurd Etymology, impoſed by ſome, *Quia intellectus in eis mæchatur*; as if theſe Arts did proſtitute and adulterate the underſtanding.

According to ordinary Signification, the Word is uſed in Oppoſition to the liberal Arts: Whereas in Propriety of Speech thoſe Employments alone may be ſtyled *Illiberal*, which require only ſome bodily Exerciſe, as Manufactures, Trades, *&c.* And on the contrary, that Diſcipline which diſcovers the general Cauſes, Effects, and Proprieties of Things, may truly be eſteemed as a *Species* of Philoſophy.

But here it ſhould be noted, that this Art is uſually diſtinguiſhed into a twofold Kind:

1. *Rational.*
2. *Chirurgical.*

Pappus Proœm. in Collect. Mathem. 1. 8.

The *Rational* is that which treats of thoſe Principles and fundamental Notions, which may concern theſe Mechanical Practices.

The *Chirurgical* or *Manual* doth refer to the making of theſe Inſtruments, and the Exerciſing of ſuch particular Experiments. As in the Works of Architecture, Fortifications, and the like.

The firſt of theſe is the Subject of this Diſcourſe, and may properly be ſtyled *Liberal*, as juſtly deſerving the Proſecution of an ingenious Mind. For if we conſider it according to its Birth and Original, we ſhall find it to ſpring from honourable Pa-

rentage, being produced by *Geometry* on the one ſide, and *natural Philoſophy* on the other. If according to its Uſe and Benefit, we may then diſcern that to this ſhould be referred all thoſe Arts and Profeſſions, ſo neceſſary for human Society, whereby Nature is not only directed in her uſual Courſe, but ſometimes alſo commanded againſt her own Law. The Particulars that concern Architecture, Navigation, Husbandry, Military Affairs, *&c.* are moſt of them reducible to this Art, both for their Invention and Uſe.

Thoſe other Diſciplines of Logick, Rhetorick, *&c.* do not more protect and adorn the Mind, than theſe Mechanical Powers do the Body.

And therefore are they well worthy to be entertained with greater Induſtry and Reſpect, than they commonly meet with in theſe Times; wherein there be very many that pretend to be Maſters in all the Liberal Arts, who ſcarce underſtand any Thing in theſe Particulars.

The Subject of this Art is concerning the Heavineſs of ſeveral Bodies, or the Proportion that is required betwixt any Weight, in relation to the Power which may be able to move it. And ſo it refers likewiſe to violent and artificial Motion, as Philoſophy doth to that which is natural.

The proper End for which this Art is intended, is to teach how by Underſtanding the true Difference betwixt the *Weight* and the *Power*, a Man may add ſuch a fitting Supplement to the Strength of the Power, that it ſhall be able to move any conceivable Weight, though it ſhould never ſo much exceed that Force which the Power is naturally endowed with.

The Art it ſelf may be thus deſcribed to be a Mathematical Diſcipline, which by the Help of Geometrical Principles doth teach to contrive ſeveral Weights and Powers unto any kind, either of Mo-

tion

tion, or Reſt, according as the Artificer ſhall determine.

If it be doubted how this may be eſteemed a *Species* of Mathematicks, when as it treats of Weights, and not of Quantity: For Satisfaction to this, there are two Particulars conſiderable. *Dav. Rivaltus præf. in l. Archim. de centro gravitatis.*

1. *Mathematicks* in its Latitude is uſually divided into *Pure* and *Mixed*: And though the *Pure* do handle only *abſtract Quantity* in the *General*, as *Geometry*, *Arithmetick*: Yet that which is *mixed*, doth conſider the Quantity of ſome *particular determinate* Subject. So *Aſtronomy* handles the Quantity of Heavenly Motions; *Muſick* of Sounds, and *Mechanicks* of Weights and Powers.

2. Heavineſs or Weight is not here conſidered, as being ſuch a natural *Quality*, whereby condenſed Bodies do of themſelves *tend downwards*; but rather, as being an Affection, whereby they may be meaſured. And in this Senſe, *Ariſtotle* himſelf refers it amongſt the other *Species* of *Quantity*, as having the ſame proper Eſſence, which is to be compounded of integral Parts. So a Pound doth conſiſt of Ounces, Drams, Scruples. Whence it is evident, that there is not any ſuch Repugnancy in the Subject of this Art, as may hinder it from being a true *Species* of *Mathematicks*. *Metaph. lib. 10. c. 2.*

CHAP. III.

Of the firſt Mechanical Faculty, the Balance.

THE Mechanical Faculties by which the Experiments of this Nature muſt be contrived, are uſually reckoned to be theſe Six.

1. *Libra.*	1. *The Ballance.*
2. *Vectis.*	2. *The Leaver.*
3. *Axis in Peritrochio.*	3. *The Wheel.*
4. *Trochlea.*	4. *The Pulley.*
5. *Cuneus.*	5. *The Wedge.*
6. *Cochlea.*	6. *The Screw.*

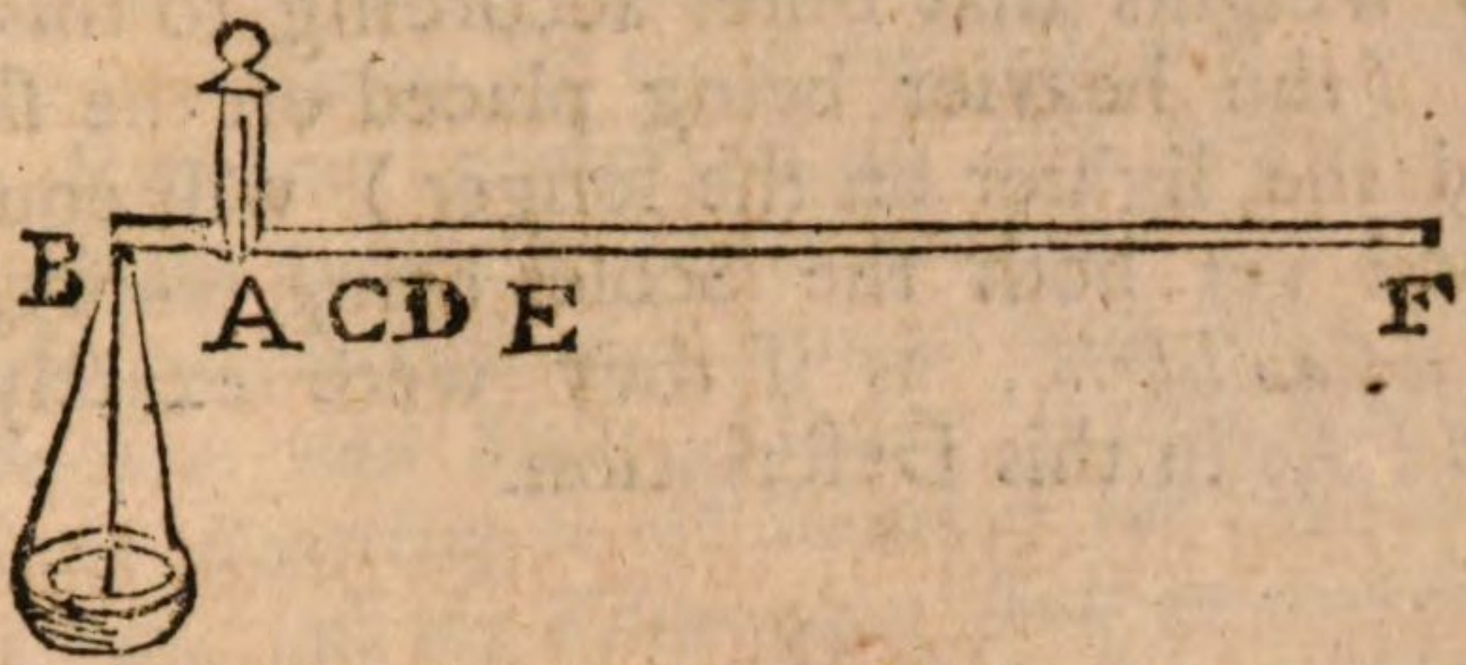
Unto ſome of which, the Force of all Mechanical Inventions muſt neceſſarily be reduced. I ſhall ſpeak of them ſeverally, and in this Order.

Firſt, concerning the Balance: This and the Leaver are uſually confounded together, as being but one Faculty; becauſe the general Grounds and Proportions of either's Force is ſo exactly the ſame. But for better Diſtinction, and more clear Diſcovery of their Natures, I ſhall treat of them ſeverally.

The firſt Invention of the Balance is commonly attributed to *Aſtrea*, who is therefore deified for the Goddeſs of Juſtice; and that Inſtrument it ſelf advanced amongſt the Celeſtial Signs.

The Particulars concerning it are ſo commonly known, and of ſuch eaſie Experiment, that they will not need any large Explication. The chief End and Purpoſe of it, is for the Diſtinction of ſeveral Ponderoſities: For the Underſtanding of which, we muſt note, that if the Length of the Sides in the Balance, and the Weights at the Ends of them, be both mutually equal, then the Beam will be in a horizontal Situation. But on the contrary, if either the Weights alone be equal, and not their Diſtances, or the Diſtances alone, and not the Weights, then the Beam will accordingly decline.

As in this following Diagram.



Suppoſe an equal Weight at *C*, unto that at *B*; (which Points are both equally diſtant from the Center *A*) it is evident that then the Beam *B F* will hang horizontally. But if the Weight ſuppoſed at *C*, be unequal to that at *B*, or if there be an equal Weight at *D E*, or any of the other unequal Diſtances; the Beam muſt then neceſſarily decline.

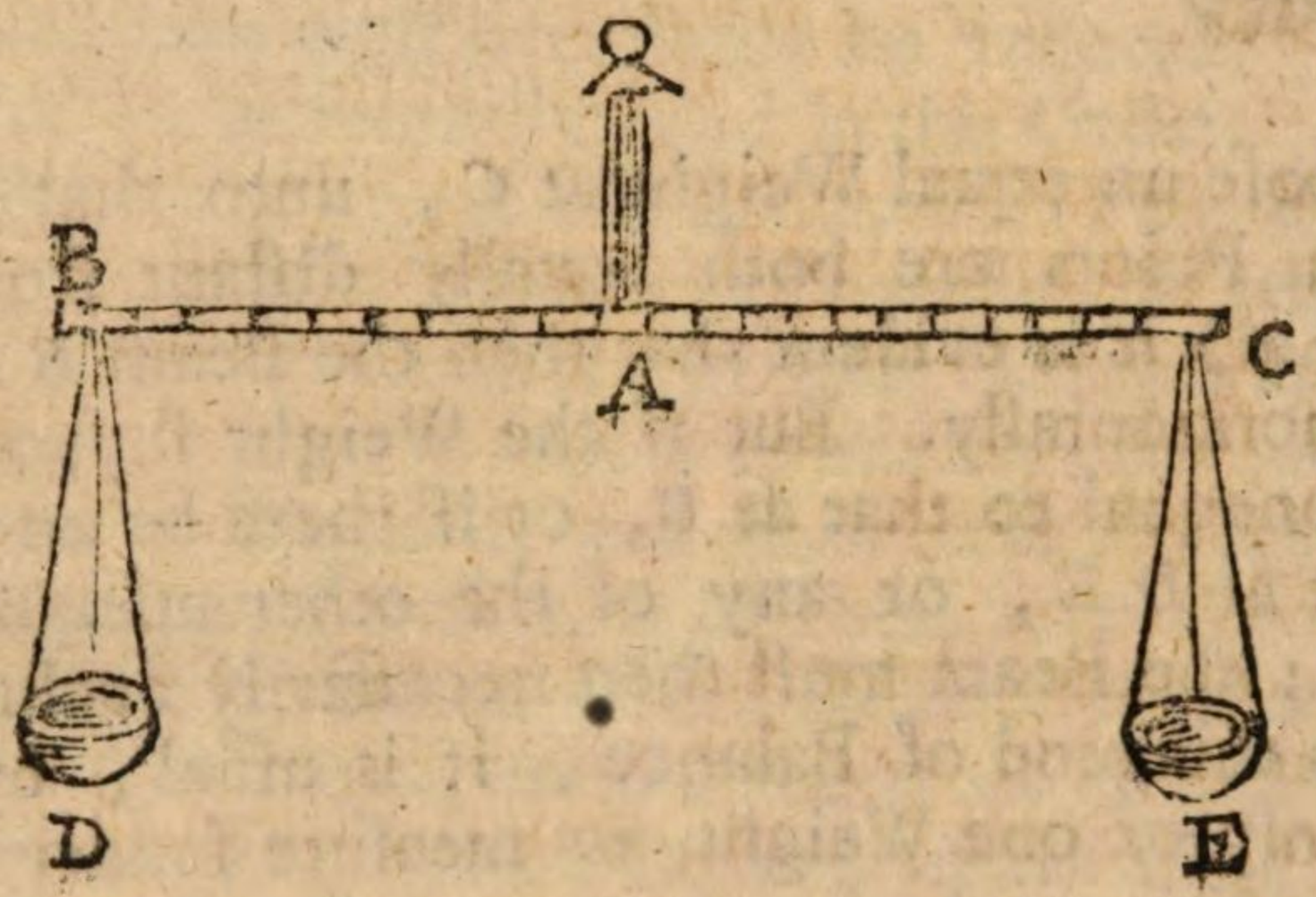
With this kind of Balance, it is uſual, by the Help only of one Weight, to meaſure ſundry different Gravities, whether more or leſs, than that by which they are meaſured. As by the Example here deſcribed, a Man may with one Pound alone, weigh any other Body within ten Pounds; becauſe the Heavineſs of any Weight doth increaſe proportionably to its Diſtance from the Center. Thus one Pound at *D*, will equiponderate unto two Pounds at *B*; becauſe the Diſtance *A D* is double unto *A B*. And for the ſame Reaſon, one Pound at *E*, will equiponderate to three Pound at *B*; and one Pound at *F*, unto ten at *B*; becauſe there is ſtill the ſame Diſproportion betwixt their ſeveral Diſtances. *Cardan. Subtil. l.* 11.

This kind of Ballance is uſually ſtiled *Romana Statera*. It ſeems to be of ancient Uſe, and is mentioned by *Ariſtotle* under the Name of φάλαγξ. *Mechan. c.* 21.

Hence it is eaſy to apprehend how that falſe Balance may be compoſed, ſo often condemned by the Wiſe-man, as being *an Abomination to the Lord*. If the Sides of the Beam be not equally divided, as *Prov.* 11. 1. *c.* 16. 11. *Item, cap.* 20. 10, 23.

Pappus Collect. Math. l. 8.

ſuppoſe one have 10 Parts, and the other 11; then any two Weights that differ according to this Proportion, (the heavier being placed on the ſhorter ſide, and the lighter on the longer) will equiponderate; and yet both the Scoles being empty, will hang in *Æquilibrio*, as if they were exactly juſt and true: As in this Deſcription.



Suppoſe *A C* to have 11 ſuch Parts, whereof *A B* has but 10, and yet both of them to be in themſelves of equal Weight; it is certain, that whether the Scoles be empty, or whether in the Scole *D* we put 11 Pound, and at *E* 10 Pound; yet both of them ſhall equiponderate, becauſe there is juſt ſuch a Diſproportion in the Length of the Sides *A C*, being unto *A B*, as 11 to 10.

The Frequency of ſuch Cozenages in theſe Days, may be evident from common Experience; and that they were uſed alſo in former Ages, may appear from *Ariſtotle*'s Teſtimony concerning the Merchants in his time. For the remedying of ſuch Abuſes, the Ancients did appoint divers Officers, ſtiled ζυγοστάται, who were to overlook the common Meaſures.

Quæſtion. Mechan. c. 2. Budæus.

Hence the Proverb, *Zygoſtatica Fides.*

So great Care was there amongſt the *Jews*, for the Preſervation of Commutative Juſtice from all Abuſe

Abuſe and Falſification in this kind, that the Publick Standards and Originals, by which all other Meaſures were to be try'd and allow'd, were with much Religion preſerved in the Sanctuary; the Care of them being committed to the Prieſts and *Levites*, whoſe Office it was to look unto *all manner of Meaſures and Size.* Hence is that frequent Expreſſion, *According to the Shekel of the Sanctuary*; and that Law, *All thy Eſtimations ſhall be according to the Shekel of the Sanctuary*: Which doth not refer to any Weight, or Coin, diſtinct from, and more than the Vulgar, (as ſome fondly conceive) but doth only oblige Men in their Dealing and Traffick, to make uſe of ſuch juſt Meaſures, as were agreeable unto the Publick Standards that were kept in the Sanctuary.

1 Chron. 23. 29. Exod. 30. 13. Lev. 27. 25.

The manner how ſuch Deceitful Balances may be diſcovered, is, by changing the Weights into each other Scole, and then the Inequality will be manifeſt.

From the former Grounds rightly apprehended, it is eaſy to conceive how a Man may find out the juſt Proportion of a Weight, which in any Point given, ſhall equiponderate to ſeveral Weights given, hanging in ſeveral Places of the Beam.

Some of theſe Balances are made ſo exact, (thoſe eſpecially which the Refiners uſe) as to be ſenſibly turned with the Eighthieth Part of a Grain: Which (tho' it may ſeem very ſtrange) is nothing to what * *Capellus* relates of one at *Sedan*, that would turn with the Four hundredth Part of a Grain.

Maſter *Greaves's* Roman Foot.

There are ſeveral Contrivances to make uſe of theſe, in meaſuring the Weight of Blows, the Force of Powder, the Strength of Strings, or other Oblong Subſtances; Condenſed Air; the diſtinct Proportion of ſeveral Metals mixed together; the different Gravity of divers Bodies in the Water, from what they have in the open Air; with divers the like ingenious Enquiries.

* *De ponderibus & nummis, l.* 1.

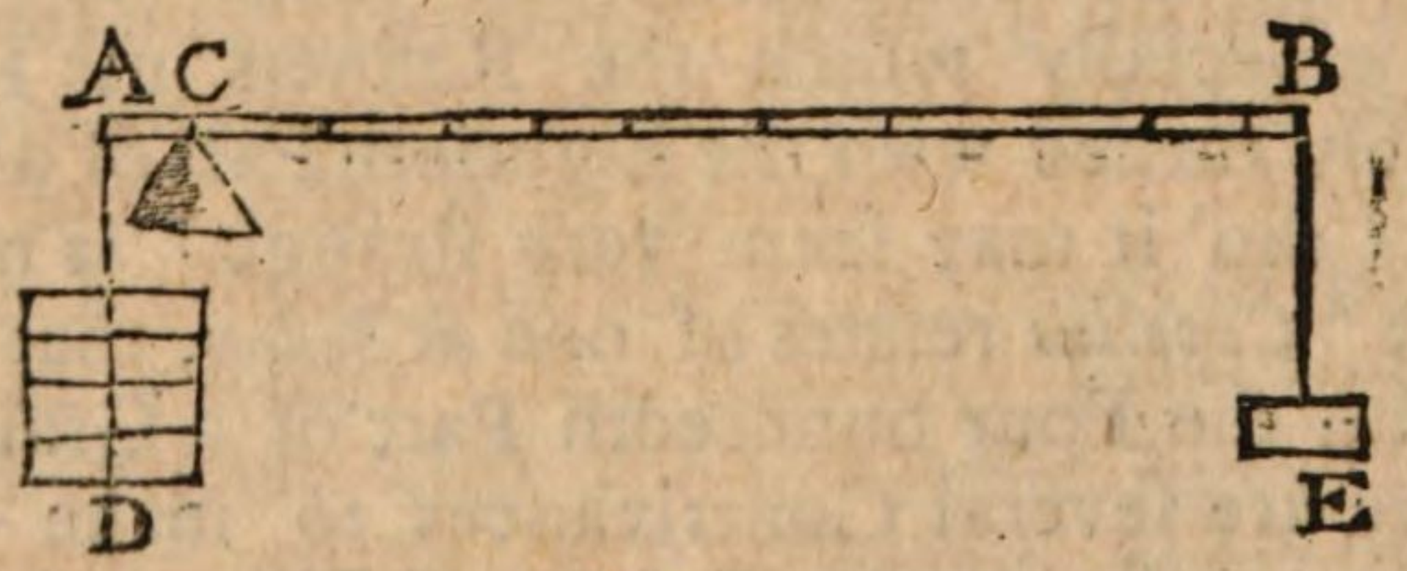
CHAP. IV.

Concerning the ſecond Mechanick Faculty, the Leaver.

THE ſecond Mechanical Faculty, is the Leaver: The firſt Invention of it is uſually aſcribed to *Neptune*, and repreſented by his Trident, which in the *Greek* are both called by one Name, and are not very unlike in Form, being both of them ſomewhat broader at one end, than in the other parts.

μόχλος. *Ariſtotle Quæſt. Mechan. cap. 4 Archimedes, de Æquiponderant. l. 1. prop. 7. Vitruvius Architect. l. 10. c. 8.*

There is one main Principle concerning it, which is (as it were) the very Sum and Epitome of this whole Art. The meaning of it is thus expreſſed by *Ariſtotle*, Ὁ τὸ κινούμενον βάρος πρὸς τὸ κινοῦν, τὸ μῆκος πρὸς τὸ μῆκος ἀνταπέπονθεν. That is, as the Weight is to an equivalent Power, ſo is the diſtance betwixt the Weight and the Center, unto the diſtance betwixt the Center and the Power, and ſo reciprocally. Or thus, the Power that doth equiponderate with any Weight, muſt have the ſame proportion unto it, as there is betwixt their ſeveral Diſtances from the Center or Fulciment; as in this following Figure.



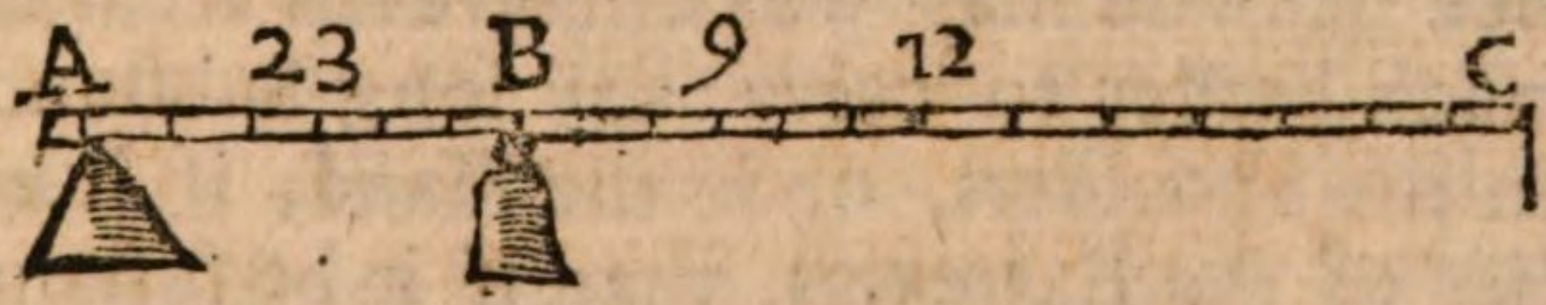
This Ariſtotle calls ἰσομόχλιον. Vitruvius, Preſſio. Whaldus Fulcimentum. Dan. Barbarus, Scabellum.

Where ſuppoſe the Leaver to be repreſented by the Length *A B*, the Center or * Prop at the Point *C*, the Weight to be ſuſtained *D*, the Power that doth uphold it *E*.

Now

Now the meaning of the foreſaid Principle doth import thus much; that the Power at *E*, muſt bear the ſame proportion to the Weight *D*, as the Diſtance *CA* doth to the other *CB*; which, becauſe it is Octuple in the preſent Example, therefore it will follow that one Pound at *B*, or *E*, will equiponderate to eight Pounds at *A*, or *D*; as is expreſſed in the Figure. The Ground of which Maxim is this, becauſe the Point *C* is ſuppoſed to be the Center of Gravity, on either ſide of which, the Parts are of equal Weight.

And this kind of proportion is not only to be obſerved when the Power doth *preſs downwards*, (as in the former Example) but alſo in the other Species of violent Motion; as *Lifting*, *Drawing*, and the like. Thus if the Prop or Fulciment were ſuppoſed to be at the extremity of the Leaver,

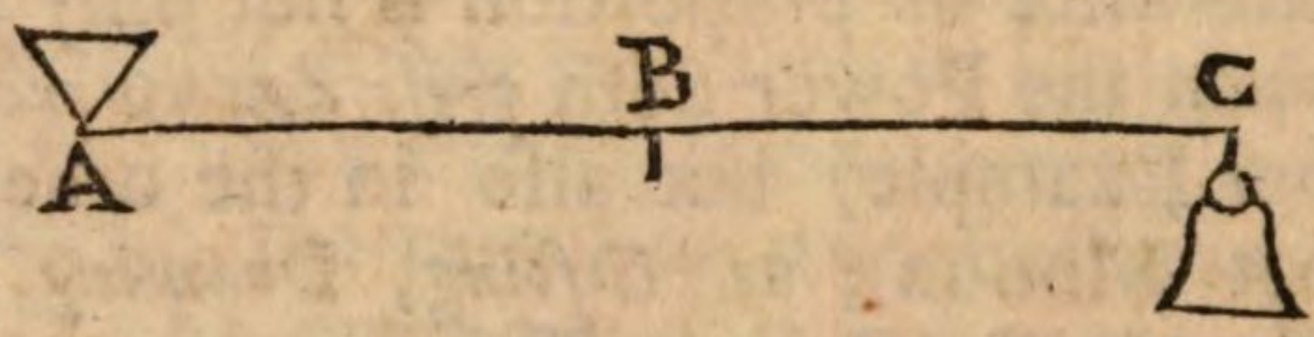


as in this Diagram at *A*, then the Weight *B* would require ſuch a difference in the Strengths or Powers that did ſuſtain it, as there is betwixt the ſeveral Diſtances *A C*, and *B C*. For as the Diſtance *AB* is unto *AC*, ſo is the Power at *C* to the Weight at *B*; that is, the Power at *A* muſt be double to that at *C*, becauſe the Diſtance *BC* is twice as much as *BA*. From whence it is eaſie to conceive, how any Burden carried betwixt two Perſons, may be proportioned according to their different Strengths. If the Weight were imagined to hang at the Number 2, then the Power at *C* would ſuſtain but two of thoſe Parts, whereof that at *A* did uphold 16. If it be ſuppoſed at the Figure 3, then the Strength at *C*, to that at *A*, would be but as Three to Fifteen.

The right underſtanding of this doth much conduce to the Explication of the Pulley.

teen. But if it were ſituated at the Figure 9, then each of the Extremities would participate of it alike; becauſe that being the middle, both the Diſtances are equal. If at the Number 12, then the Strength at *C* is required to be double unto that at *A*. And in the like manner are we to conceive of the other intermediate Diviſions.

Thus alſo muſt it be, if we ſuppoſe the Power to be placed betwixt the Fulciment and the Weight, as in this Example.

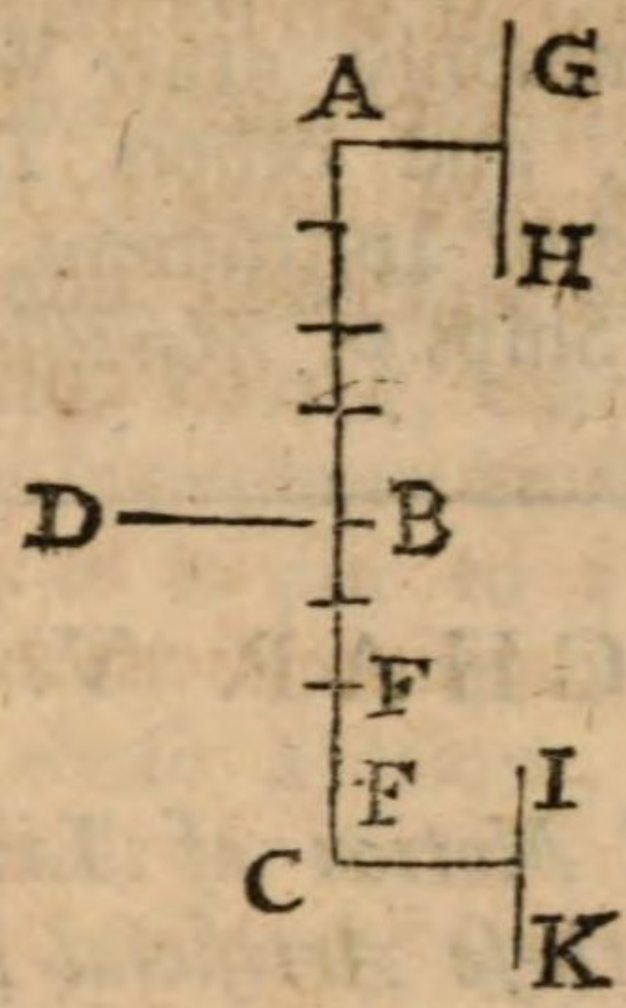


Where, as *A C* is to *A B* ſo is the Power at *B*, to the Weight at *C*.

Hence likewiſe may we conceive the Reaſon why it is much harder to carry any long Subſtance, either on the Shoulders, or in the Hand, if it be held by either of the Extreams, than if it be ſuſtained by the middle of it. The Strength that muſt equiponderate at the nearer end, ſometimes increaſing the Weight almoſt double to what it is in it ſelf.

Imagine the Point *A* to be the place where any long Subſtance (as ſuppoſe a Pike) is ſuſtained; it is evident from the former Principle, that the ſtrength at *B* (which makes it lie level) muſt be equal to all the length *A C*, which is almoſt the whole Pike.

And as it is in the depreſſing, or elevating, ſo likewiſe is it in the drawing of any Weight, as a Coach, Plow, or the like. Let



Let the Line *D B* repreſent the Pole or Carriage on which the Burden is ſuſtained, and the Line *A C* the Croſs-Bar; at each of its Extremities, there is a ſeveral Spring-Tree *G H*, and *I K*, to which either Horſes or Oxen may be faſtned. Now becauſe *A* and *C* are equally diſtant from the middle *B*, therefore in this caſe the Strength muſt be equal on both ſides; but if we ſuppoſe one of theſe Spring-Trees to be faſtned unto the Points *E* or *F*, then the Strength required to draw on that ſide, will be ſo much more, as the diſtance *E B* or *F B* is leſs than that of *A B*; that is, either as three to four, as *E B* to *B A*, or as one to two, as *F B* to *B A*. So that the Beaſt faſtned at *A*, will not draw ſo much by a quarter as the other at *E*, but half as much as one at *F*.

Whence it is eaſie to conceive how a Husbandman (*cum inæquales veniunt ad aratra juvenci*) may proportion the Labour of Drawing, according to the ſeveral ſtrength of his Oxen.

Unto this Mechanical Faculty ſhould be reduced ſundry other Inſtruments in common uſe. Thus the Oars, Stern, Maſts, *&c.* according to their force whereby they give Motion to the Ship, are to be conceived under this Head. Thus

Ariſt. Mechan. c. 5, 6, 7 Vide Guevar. Comment.

Thus likewiſe for that Engine, whereby Brewers and Dyers do commonly draw Water, which *Ariſtotle* calls κηλώνειον, and others *Tollenon*. This being the ſame kind of Inſtrument, by which *Archimedes* drew up the Ships of *Marcellus*.

Mechan. c. 29. Pet. Crinitus, de honeſta Diſciplina l. 19. c. 2. calls it corruptly *Tellenon.*

CHAP. V.

How the Natural Motion of Living Creatures is conformable to theſe Artificial Rules.

THE former Principle being already explained, concerning artificial and dead Motions, it will not be altogether impertinent, if in the next place we apply it unto thoſe that are natural in living Bodies, and examine whether theſe alſo are not governed by the ſame kind of Proportions.

In all perfect living Creatures, there is a twofold kind of motive Inſtruments:

1. Primary, the Muſcles.
2. Secondary, the Members.

The Muſcles are naturally fitted to be Inſtruments of Motion, by the manner of their Frame and Compoſure; conſiſting of Fleſh as their chief Material, and beſides of Nerves, Ligatures, Veins, Arteries, and Membranes.

The *Nerves* ſerve for the conveyance of the motive Faculty from the Brain. The *Ligatures* for the ſtrengthning of them, that they may not flag and languiſh in their Motions. The *Veins* for their Nouriſhment. The *Arteries* for the ſupplying of them with Spirit and natural Vigor. The *Membranes* for the comprehenſion or incloſure of all theſe together, and for the diſtinction of one Muſcle from another. There are beſides divers *Fibræ*, or hairy Subſtances, which Nature hath beſtowed for the farther corroborating

borating of their Motions; theſe being diſperſed through every Muſcle, do ſo joyn together in the end of them, as to make entire Nervous Bodies, which are called *Tendons*, almoſt like the Griſtles. Now this (ſaith *Galen*) may fitly be compared to the broader part of the Leaver, that is put under the Weight; which, as it ought to be ſo much the ſtronger, by how much it is put to a greater force, ſo likewiſe by this, doth Nature enable the Muſcles and Nerves for thoſe Motions, which otherwiſe would be too difficult for them. *De Placit. Hippoc. & Platon. l.1. cap. 10.*

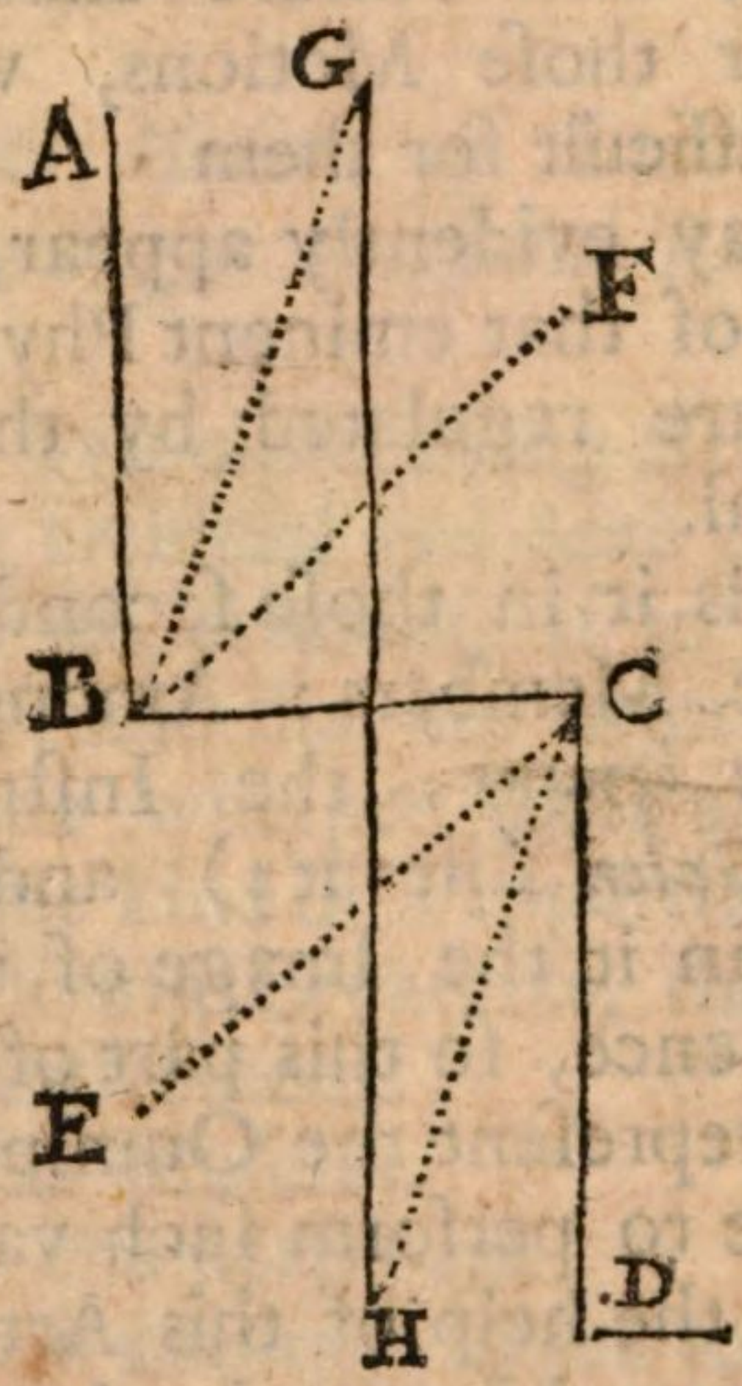
Whence it may evidently appear, that according to the Opinion of that eminent Phyſician, theſe natural Motions are regulated by the like Grounds with the artificial.

2. Thus alſo is it in thoſe ſecondary Inſtruments of Motion, the Members: Amongſt which, the Hand is ὄργανον ὀργάνων, the Inſtrument of Inſtruments, (as *Galen* ſtiles it;) and as the Soul of Man doth bear in it the Image of the Divine Wiſdom and Providence, ſo this part of the Body ſeems in ſome ſort to repreſent the Omnipotency of God, whilſt it is able to perform ſuch various and wonderful Effects by the help of this Art. But now for its own proper natural Strength, in the lifting any great Weight, this is always proportioned according to its Extenſion from the Body, being of leaſt force when it is fully ſtretched out, or at Arms-end, (as we ſay) becauſe then the Shoulder-Joynt is as the Center of its Motion, from which the Hand in that poſture being very remote, the weight of any thing it holds muſt be accordingly augmented. Whereas the Arm being drawn in, the Elbow Joynt doth then become its Center, which will diminiſh the weight proportionably, as that part is nearer unto it than the other. *De uſu part. l. 1. c. 2.*

To this purpoſe alſo, there is another ſubtle Problem propoſed by *Ariſtotle*, concerning the Poſtures of *Mechan. c. 31.*

of ſitting and riſing up. The Quære is this, Why a Man cannot riſe up from his Seat, unleſs he firſt either bend his Body forward, or thruſt his Feet backward?

In the Poſture of Sitting, our Legs are ſuppoſed to make a right Angle with our Thighs, and they with our Backs, as in this Figure.



Where let *A B* repreſent the Back, *B C* the Thighs, *C D* the Legs. Now it is evident, that a Man cannot riſe from this Poſture, unleſs either the Back *A B* do firſt incline unto *F*, to make an acute Angle with the Thighs *B C*; or elſe that the Legs *C D* do incline towards *E*, which may alſo make an acute Angle with the Thighs *B C*; or laſtly, unleſs both of them do incline to the Points *G H*, where they may be included in the ſame Perpendicular.

For the Reſolution of which, the Philoſopher propoſes theſe two Particulars.

1. A right Angle (ſaith he) is a kind of Equality, and that being naturally the Cauſe of Reſt, muſt needs be an Impediment to the Motion of Riſing.

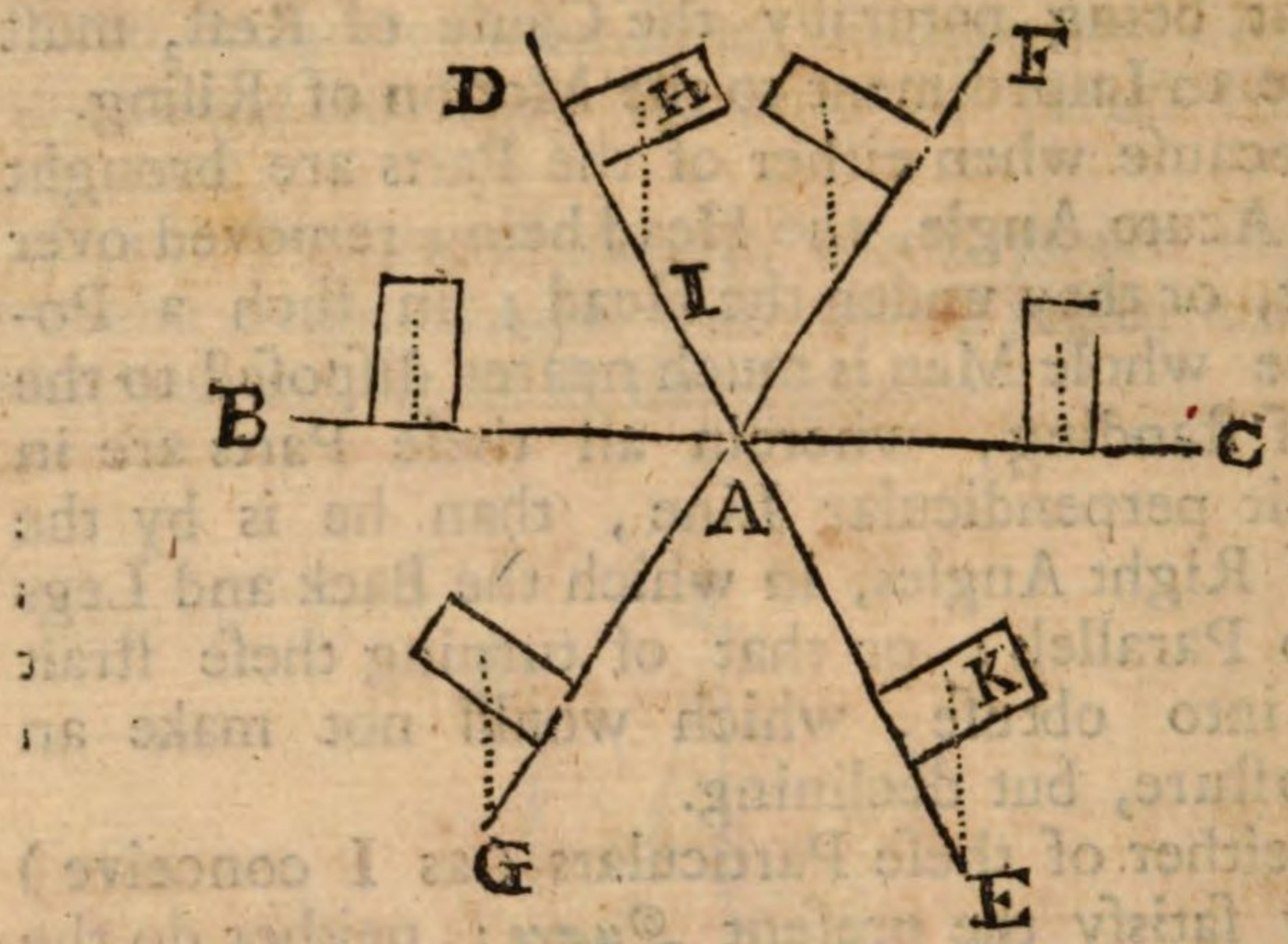
2. Becauſe when either of the Parts are brought into an Acute Angle, the Head being removed over the Feet, or they under the Head; in ſuch a Poſture the whole Man is much nearer diſpoſed to the Form of ſtanding, wherein all theſe Parts are in one ſtrait perpendicular Line, than he is by the other of Right Angles, in which the Back and Legs are two Parallels; or that of turning theſe ſtrait Angles into obtuſe, which would not make an erect Poſture, but declining.

But neither of theſe Particulars (as I conceive) do fully ſatisfy the preſent *Quære*; neither do the Commentators, *Monantholius*, or *Guevara*, better reſolve it. Rather ſuppoſe *B C* to be a *Vectis*, or Leaver, towards the Middle of which is the Place of the Fulciment, *A B* as the Weight, *C D* the Power that is to raiſe it.

Now the Body being ſituate in this Rectangular Form, the Weight *A B* muſt needs be augmented proportionably to its Diſtance from the Fulciment, which is about half the Thighs: Whereas, if we ſuppoſe either the Weight to be inclined unto *F*, or the Power to *E*, or both of them to *G H*; then there is nothing to be lifted up, but the bare Weight it ſelf; which in this Situation, is not at all increaſed with any Addition by Diſtance.

For in theſe Concluſions concerning the Leaver, we muſt always imagine that Point which is touched by a Perpendicular from the Center of Gravity, to be one of the Terms. So that the diverſe Elevation or Depreſſion of the Inſtrument, will infer a great Alteration in the Weight it ſelf; as may more clearly be diſcerned by this following Diagram.

Where



Where *A* is ſuppoſed to be the Place of the Prop, or Fulciment; *B C*, a Leaver which ſtands horizontally; the Power and the Weight belonging unto it being equal, both in themſelves, and alſo in their Diſtances from the Prop.

But now ſuppoſe this Inſtrument to be alter'd according to the Situation *D E*; then the Weight *D* will be diminiſhed by ſo much, as the Perpendicular from its Center of Gravity *H I*, doth fall nearer to the Prop or Fulciment at *A*: And the Power at *E* will be ſo much augmented, as the Perpendicular from its Center (*K E*) does fall farther from the Point at *A*. And ſo on the contrary, in that other Situation of the Leaver, *F G*: Whence it is eaſy to conceive the true Reaſon, why the Inclining of the Body, or the putting back of the Leg, ſhould ſo much conduce to the Facility of riſing.

Sir *Fr. Bacon's Nat. Hiſt. Exp.* 731.

From theſe Grounds likewiſe may we underſtand, why the Knees ſhould be moſt weary in Aſcending, and the Thighs in Deſcending; which is, becauſe the Weight of the Body doth bear moſt upon the Knee-joints, in raiſing it ſelf up; and moſt upon the

the Muſcles of the Thighs, when it ſtays it ſelf in coming down.

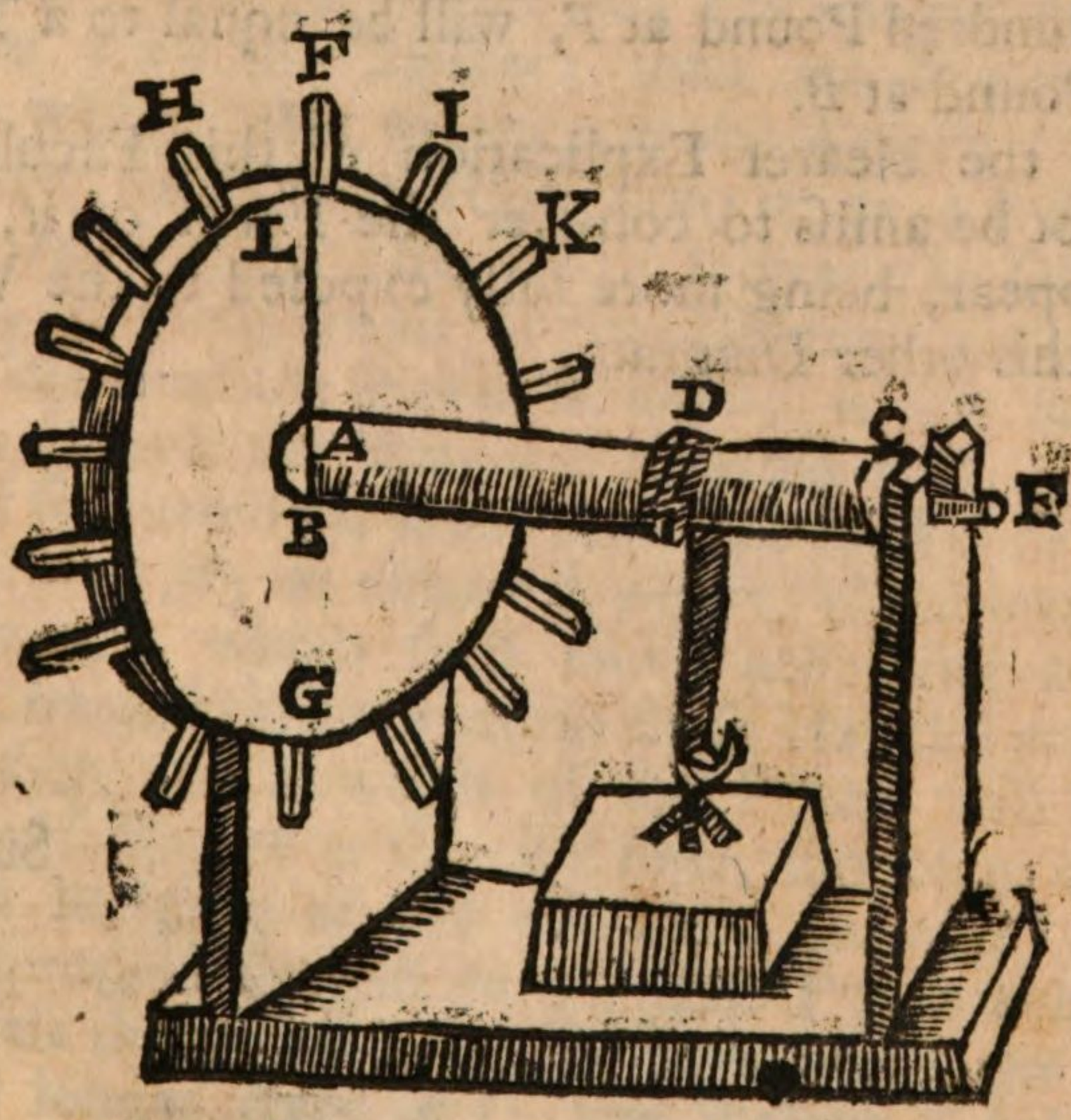
There are divers other Natural Problems to this purpoſe, which I forbear to recite. We do not ſo much as go, or ſit, or riſe, without the Uſe of this Mechanical Geometry.

CHAP. VI.

Concerning the Wheel.

THE Third Mechanical Faculty is commonly ſtiled, *Axis in Peritrochio.* It conſiſts of an Axis, or Cylinder, having a Rundle about it, wherein there are faſtned divers Spokes, by which the whole may be turned round; according to this Figure.

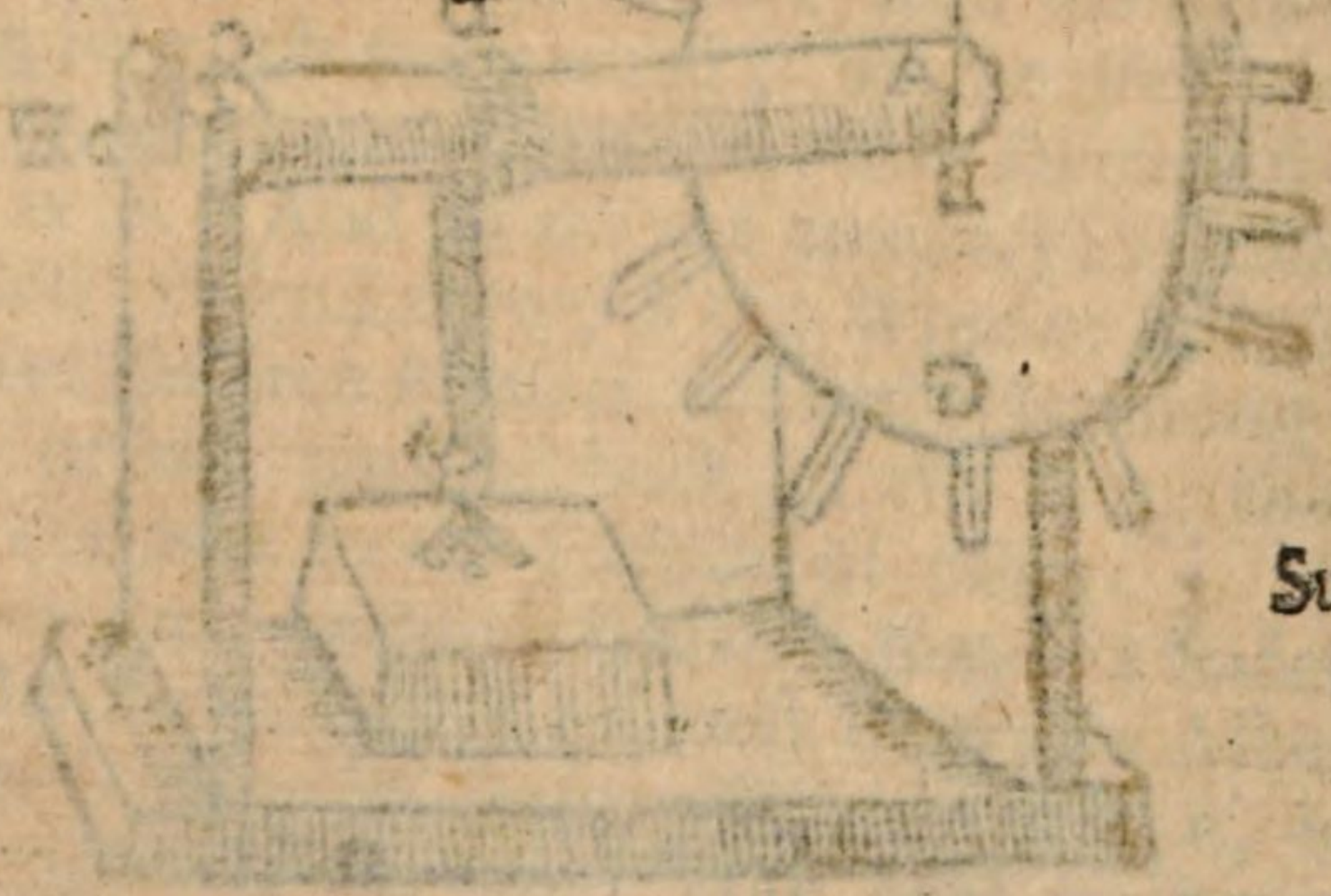
Called likewiſe ☉ ☉. *Ariſt. Mechan. c.* 14.



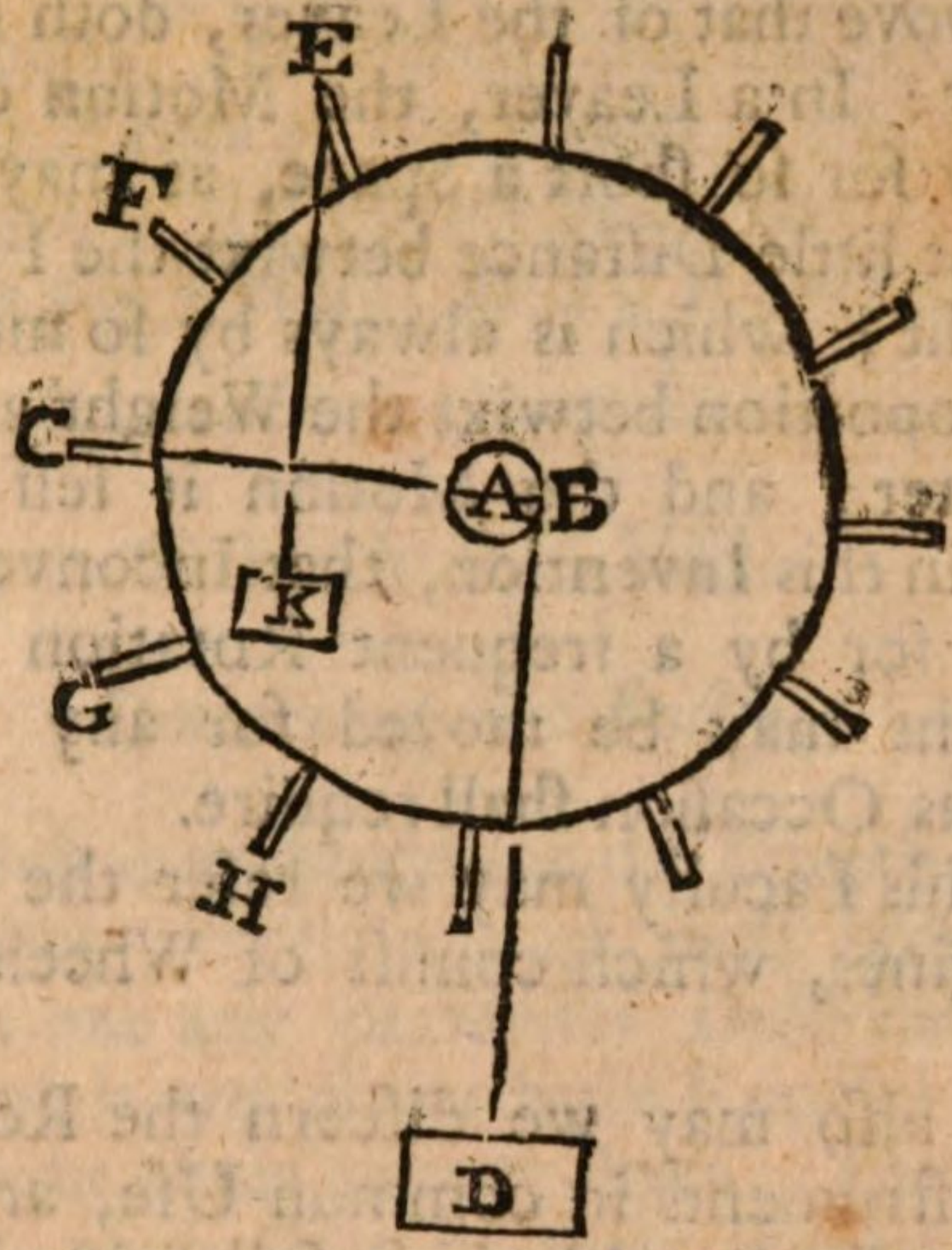
Where *B C* does repreſent the Cylinder, which is ſuppoſed to move upon a ſmaller Axis at *E*; (this being all one, in compariſon to the ſeveral Proportions, as if it were a mere Mathematical Line;) *L G* is the Rundle, or Wheel; *H F I K*, ſeveral Spokes or Handles that are faſtned in it; *D*, the Place where the Cord is faſtned, for the drawing or lifting up of any Weight.

The Force of this Inſtrument doth conſiſt in that Diſproportion of Diſtance which there is betwixt the Semidiameter of the Cylinder *A B*, and the Semidiameter of the Rundle with the Spokes, *F A*. For let us conceive the Line *F B* to be as a Leaver, wherein *A* is the Center or Fulciment, *B* the Place of the Weight, and *F* of the Power. Now it is evident from the former Principles, that by how much the Diſtance *F A* is greater than *A B*, by ſo much leſs need the Power be at *F*, in reſpect of the Weight at *B*. Suppoſe *A B* to be as the Tenth part of *A F*, then that Power or Strength, which is but as a Hundred Pound at *F*, will be equal to a Thouſand Pound at *B*.

For the clearer Explication of this Faculty, it will not be amiſs to conſider the Form of it, as it will appear, being more fully expoſed to the View: As in this other Diagram.



Suppoſe



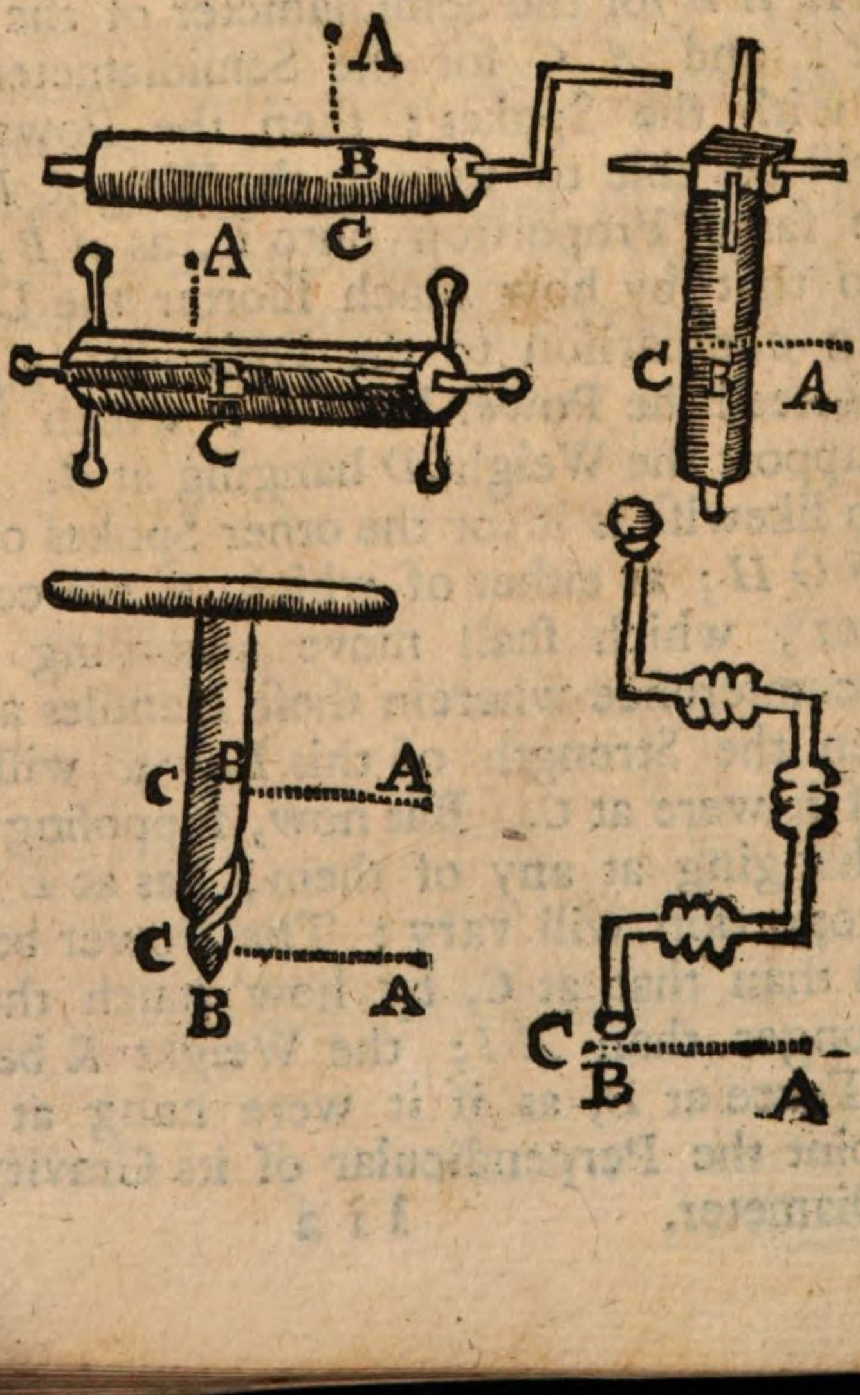
Suppoſe *A B* for the Semidiameter of the Axis or Cylinder, and *A C* for the Semidiameter of the Rundle with the Spokes; then the Power at *C*, which will be able to ſupport the Weight *D*, muſt bear the ſame Proportion unto it, as *A B* doth to *A C*: So that by how much ſhorter the Diſtance *A B* is, in compariſon to the Diſtance *A C*, by ſo much leſs need the Power be at *C*, which may be able to ſupport the Weight *D* hanging at *B*.

And ſo likewiſe is it for the other Spokes or Handles, *E F G H*; at either of which, if we conceive any Power, which ſhall move according to the ſame Circumference wherein theſe Handles are placed; then the Strength of this Power will be all one, as if it were at *C*. But now, ſuppoſing a dead Weight hanging at any of them, (as at *E*) then the Diſproportion will vary: The Power being ſo much leſs than that at *C*, by how much the Line *A C* is longer than *A I*; the Weight *K* being of the ſame Force at *E*, as if it were hung at *I*, in which Point the Perpendicular of its Gravity doth cut the Diameter.

The chief Advantage which this Inſtrument doth beſtow above that of the Leaver, doth conſiſt in this Particular: In a Leaver, the Motion can be continued only for ſo ſhort a Space, as may be anſwerable to that little Diſtance betwixt the Fulciment and the Weight; which is always by ſo much leſſer, as the Diſproportion betwixt the Weight and the Power is greater, and the Motion it ſelf more eaſy: But now in this Invention, that Inconvenience is remedied; for by a frequent Rotation of the Axis, the Weight may be moved for any Height, or Length, as Occaſion ſhall require.

Unto this Faculty may we refer the Force of all thoſe Engines, which conſiſt of Wheels with Teeth in them.

Hence alſo may we diſcern the Reaſon, why ſundry Inſtruments in common Uſe, are framed after the like Form with theſe following Figures.



An

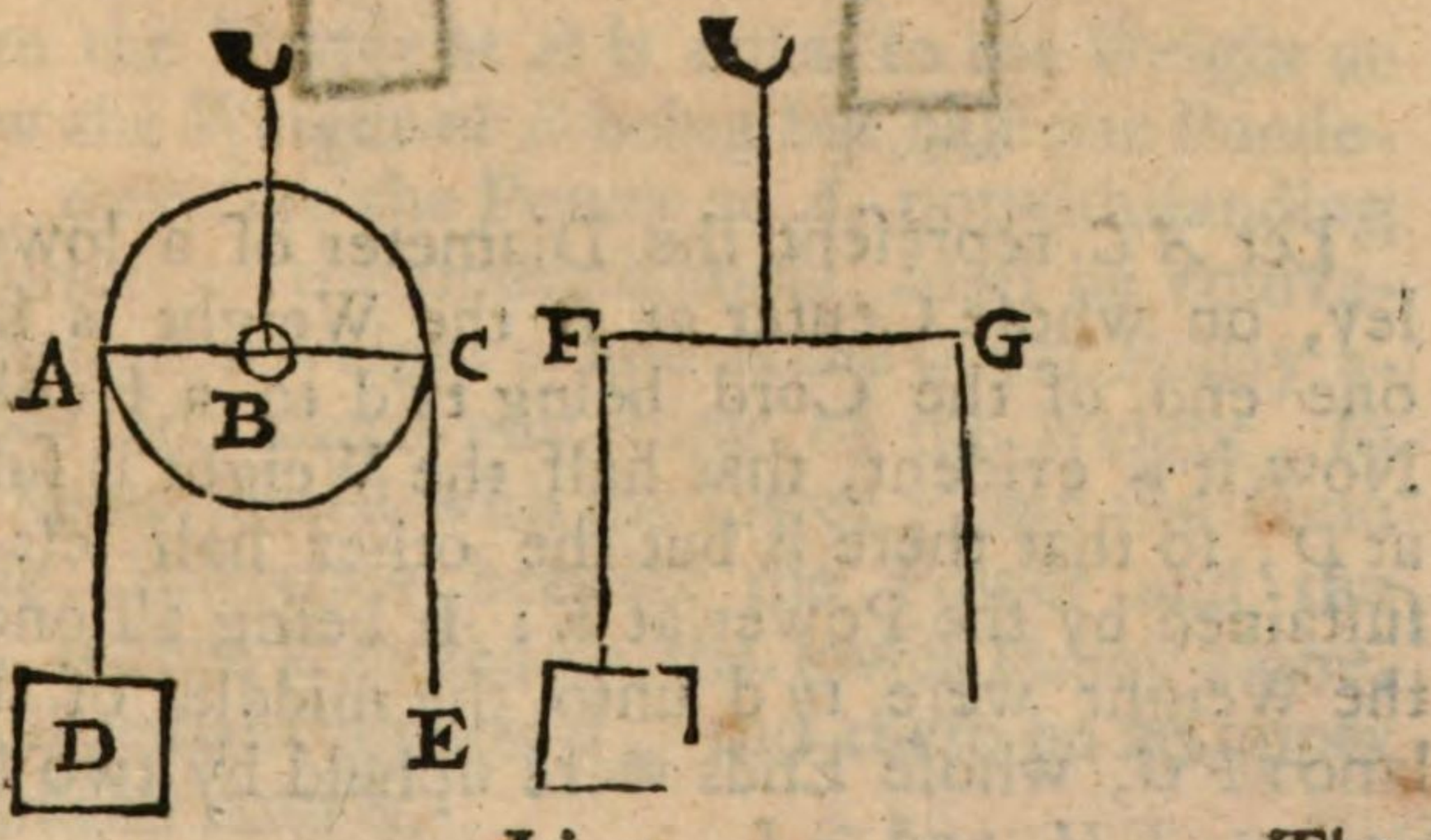
All which are but ſeveral kinds of this Third Mechanical Faculty. In which, the Points *A B C* do repreſent the Places of the Power, the Fulciment, and the Weight; the Power being in the ſame proportion unto the Weight, as *B C* is unto *B A*.

CHAP. VII.

Concerning the Pulley.

THat which is reckon'd for the Fourth Faculty, is the Pulley; which is of ſuch ordinary Uſe, that it needs not any particular Deſcription. The chief Parts of it are divers little Rundles, that are moveable about their proper Axes. Theſe are uſually divided, according to their ſeveral Situations, into the upper and lower. If an Engine have two of theſe Rundles above, and two below; it is uſually called δίσπαστος, if three, τρίσπαστος, if many, πολύσπαστος. *Ariſt. Mechan. c. 19.*

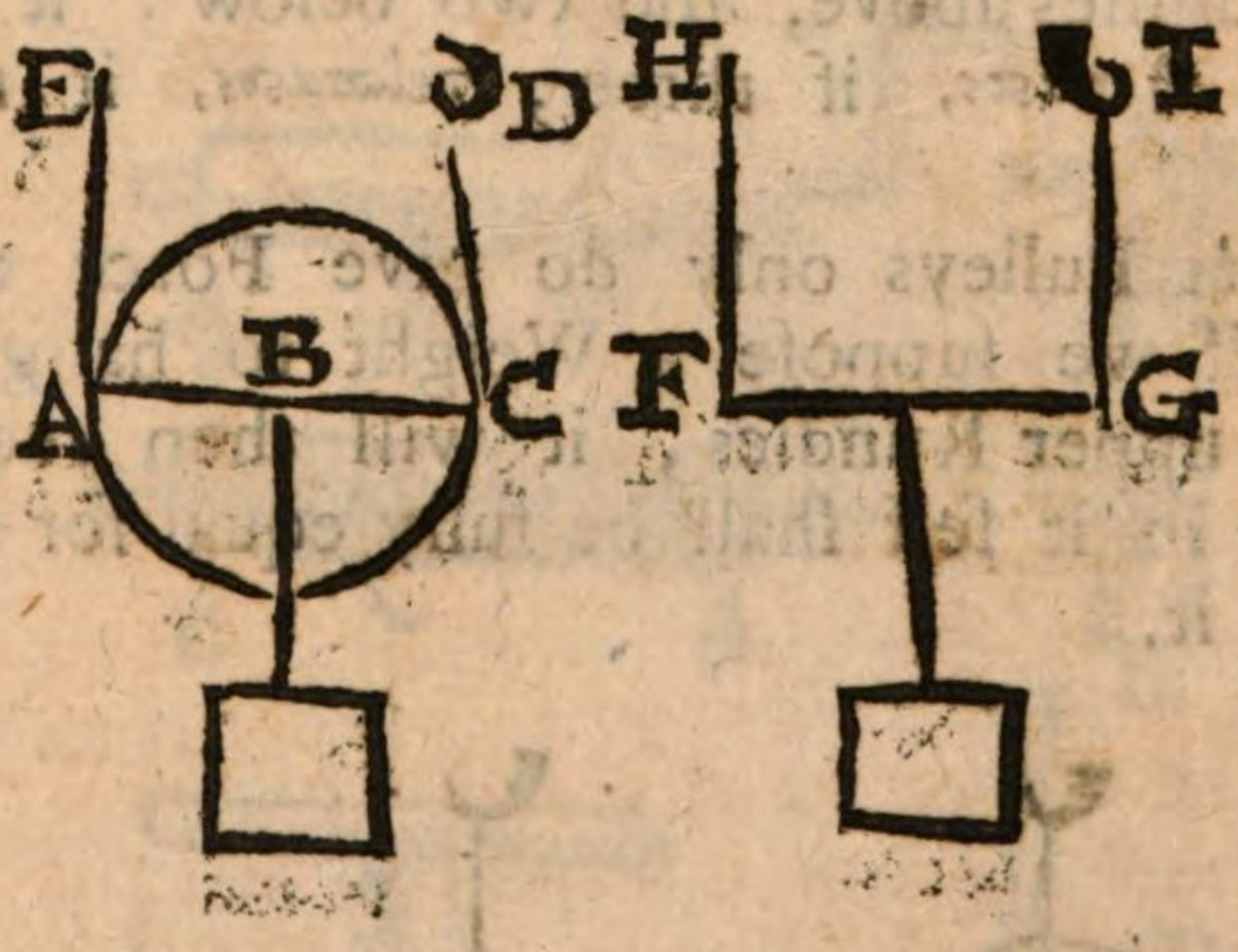
The lower Pulleys only do give Force to the Motion. If we ſuppoſe a Weight to hang upon any of the upper Rundles, it will then require a Power that in it ſelf ſhall be fully equal for the ſuſtaining of it.



The Diameter *A C* being as the Beam of a Balance, of which *B* is the Prop or Center. Now the Parts *A* and *C* being equally distant from this Center, therefore the Power at *E* must be equal to the Weight at *D*; it being all one, as if the Power and the Weight were fastned by two several Strings, at the Ends of the Balance *F G*.

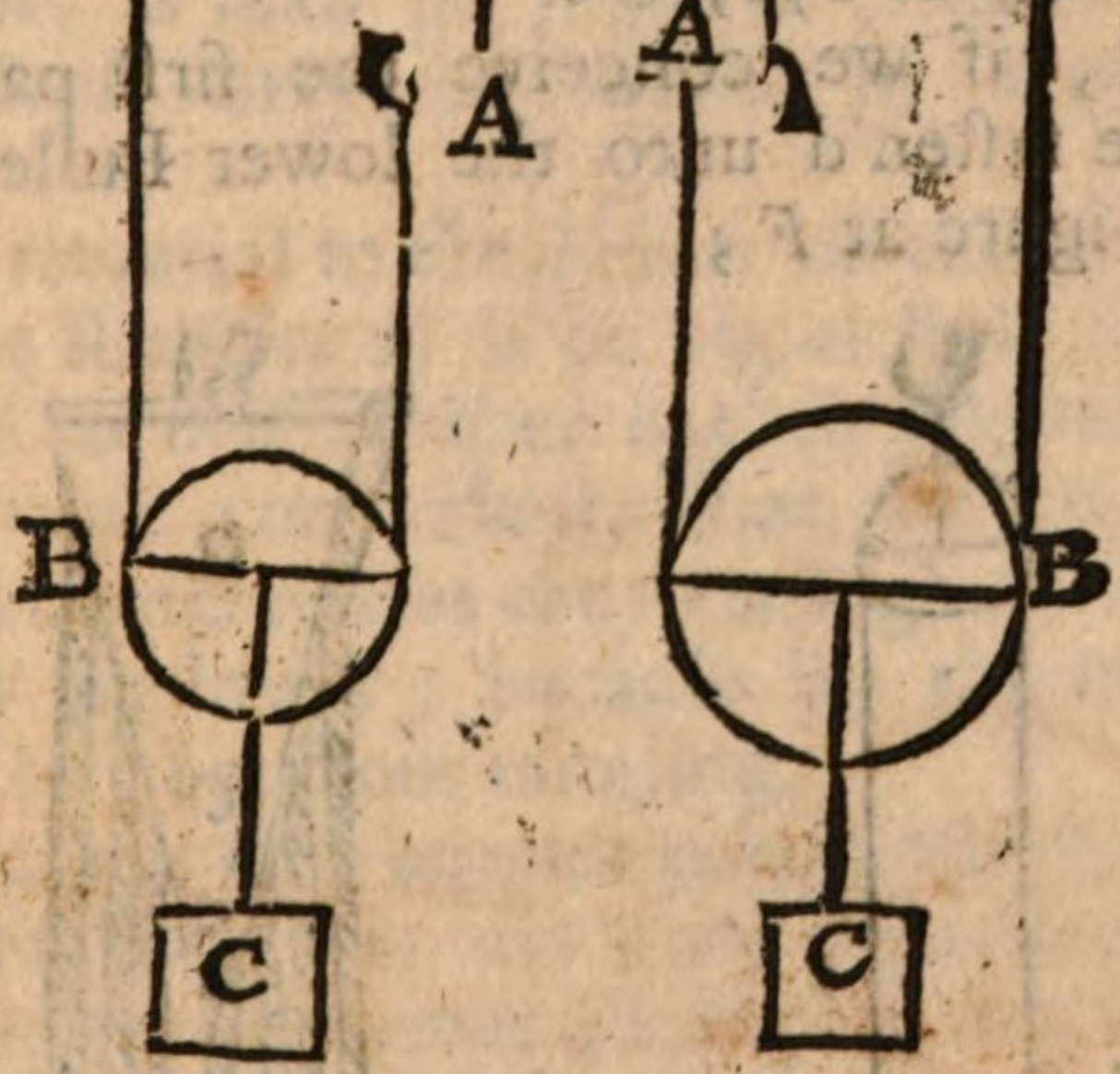
Now all the upper Pulleys being of the same Nature, it must necessarily follow, that none of them do in themselves conduce to the easing of the Power, or lightening the Weight, but only for the greater Conveniency of the Motion; the Cords by this means running more easily moved, than otherwise they would.

But now, suppose the Weight to be sustained above the Pulley, as it is in all those of the lower sort; and then the Power which supports it, need be but half as much as the Weight it self.



Let *A C* represent the Diameter of a lower Pulley, on whose Center at *B* the Weight is fastned, one end of the Cord being ty'd to a Hook at *D*: Now it is evident, that half the Weight is sustained at *D*, so that there is but the other half left to be sustained by the Power at *E*: It being all one, as if the Weight were ty'd unto the middle of the Balance *F G*, whose Ends were upheld by two several Strings, *F H*, and *G I*. And

And this ſame Subduple Proportion will ſtill remain, tho' we ſuppoſe an upper Pulley joined to the Power; as in theſe two other Figures.

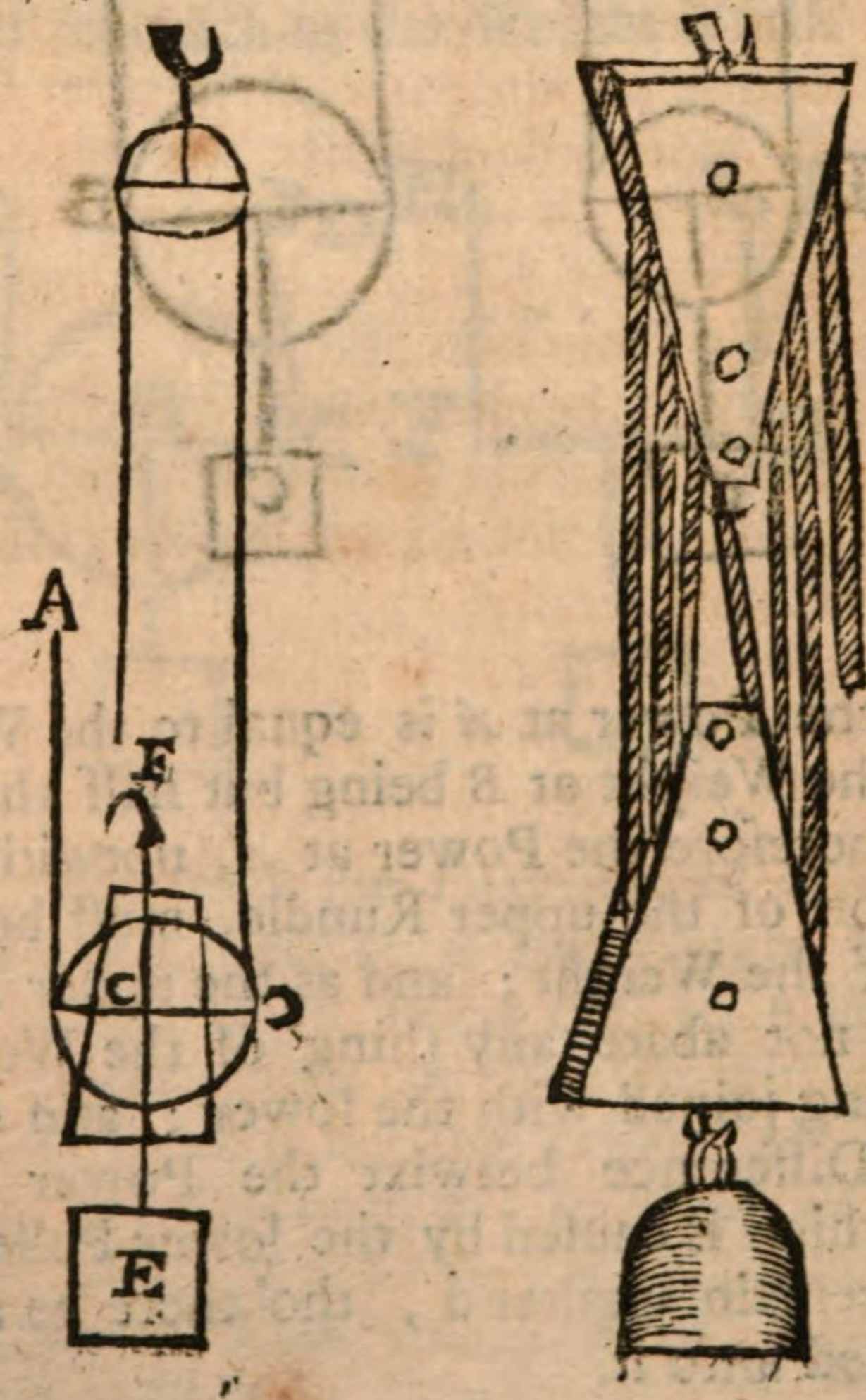


Where the Power at *A* is equal to the Weight at *B*: Now the Weight at *B* being but half the Ponderoſity C, therefore the Power at *A*, notwithſtanding the Addition of the upper Rundle, muſt be equivalent to half the Weight; and as the upper Pulley alone doth not abate any thing of the Weight, ſo neither being joined with the lower; and the ſame Subduple Difference betwixt the Power and the Weight, which is cauſed by the lower Pulley alone, doth ſtill remain unalter'd, tho' there be an upper Pulley added unto it.

Now, as one of these Under-Pulleys doth abate half of that Heaviness which the Weight hath in it self, and cause the Power to be in a Subduple Proportion unto it; so two of them do abate half of that which remains, and cause a Subquadruple Proportion betwixt the Weight and the Power; three of them a Subsextuple, four a Suboctuple: And so for five, six, or as many as shall be required; they will all of them diminish the Weight, according to this Proportion.

Suppose the Weight in it self to be 1200 Pound, the applying unto it one of these lower Pulleys, will make it but as 600; two of them, as 300; three of them, as 150, *&c.*

But now, if we conceive the first part of the String to be fasten'd unto the lower Pulley, as in this other Figure at *F*;



then

then the Power at *A*, will be in a ſubtriple Proportion to the Weight *E*, becauſe the Heavineſs would be then equally divided unto the Three Points of the lower Diameter *B*, *C*, *D*, each of them ſupporting a like Share of the Burden. If unto this lower Pulley there were added another, then the Power would be unto the Weight in a ſubquintuple Proportion. If a Third, a Subſextuple, and ſo of the reſt. For we muſt note, that the Cords in this Inſtrument are as ſo many Powers, and the Rundles as ſo many Leavers, or Balances.

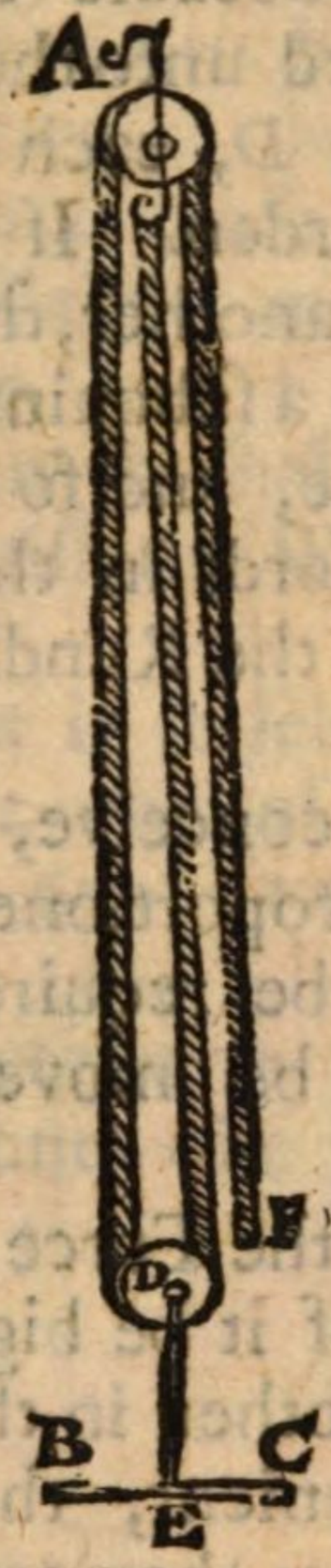
Hence it is eaſie to conceive, how the Strength of the Power may be proportioned according to any ſuch Degree, as ſhall be required; and how any Weight given may be moved by any Power given.

'Tis not material to the Force of this Inſtrument, whether the Rundles of it be big or little, if they be made equal to one another in their ſeveral Orders: But it is moſt convenient, that the upper ſhould each of them increaſe as they are higher, and the other as they are lower; becauſe by this means the Cords will be kept from tangling.

Theſe Pulleys may be multiplied according to ſundry different Situations, not only when they are ſubordinate, as in the former Examples, but alſo when they are placed collaterally.

From the former Grounds it is eaſie to contrive a Ladder, by which a Man may pull himſelf up unto any Height. For the Performance of this, there is required only an upper and a lower Rundle.

To



To the uppermoſt of theſe at *A*, there ſhould be faſtned a ſharp Grapple or Cramp of Iron, which may be apt to take hold of any Place where it lights. This part being firſt caſt up and faſtned, and the Staff *D E*, at the nether End, being put betwixt the Legs, ſo that a Man may ſit upon the other *B C*, and take hold of the Cord at *F*, it is evident that the Weight of the Perſon at *E*, will be but equal to half ſo much Strength at *F*; ſo that a Man may eaſily pull himſelf up to the Place required, by leaning but little more than half of his own Weight on the String *F*. Or if the Pulleys be multiplied, this Experiment may then be wrought with leſs Labour.

CHAP.

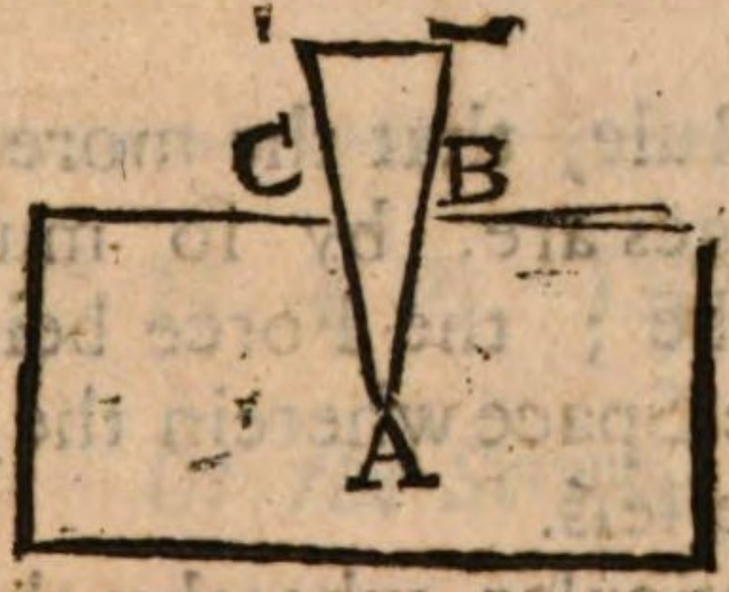
CHAP. VIII.

Of the Wedge.

THE Fifth Mechanical Faculty is the Wedge, which is a known Inſtrument, commonly uſed in the Cleaving of Wood. The Efficacy and great Strength of it may be reſolved unto theſe two Particulars:

1. The Form of it.
2. The Manner whereby the Power is impreſſed upon it, which is by the Force of Blows.

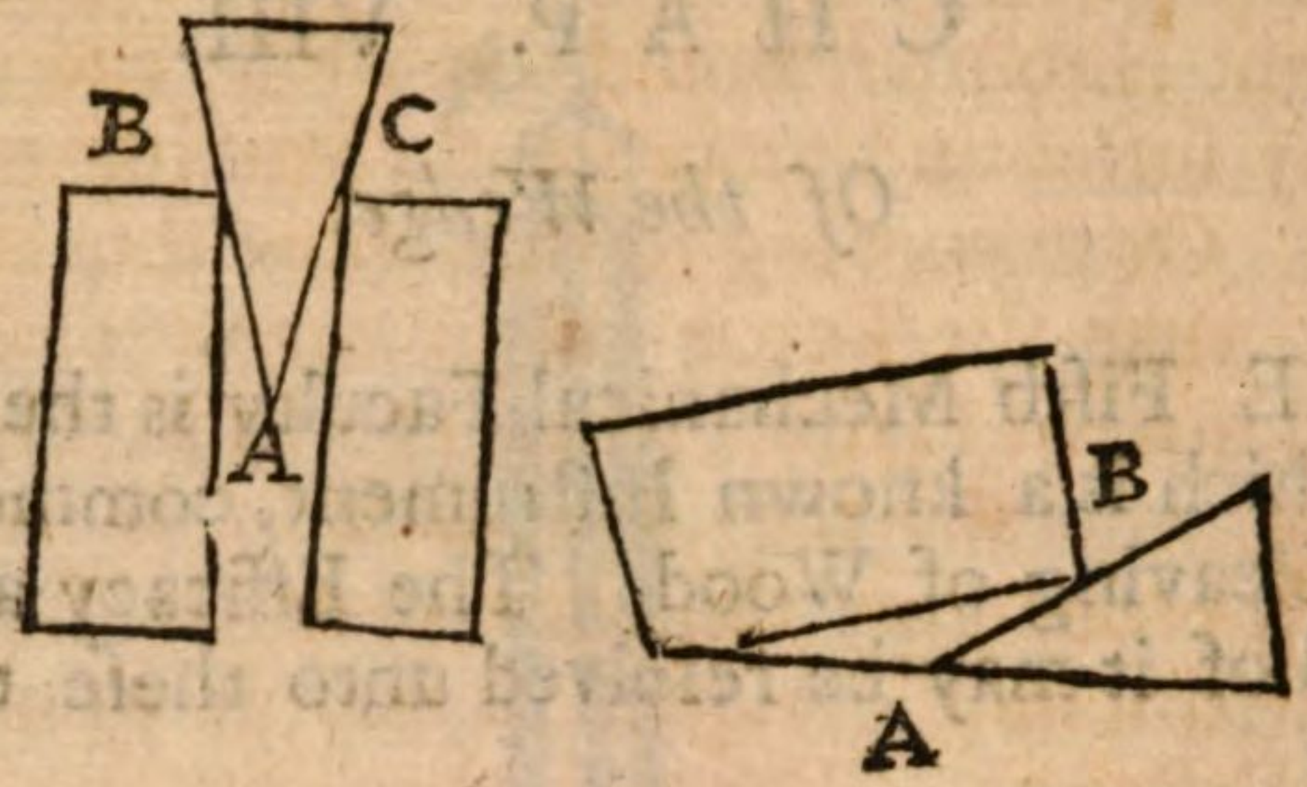
1. The Form of it repreſents (as it were) two Leavers.



Each ſide *A D*, and *A E*, being one, the Points *B C*, being inſtead of ſeveral Props or Fulciments; the Weight to be moved at *A*, and the Power that ſhould move it, being applyed to the Top *D E*, by the Force of ſome Stroke or Blow: As *Ariſtotle* hath explained the ſeveral Parts of this Faculty. But now, becauſe this Inſtrument may be ſo uſed that the Point of it ſhall not touch the Body to be moved, as in theſe other Figures:

Mechan. c. 18.

There-



Therefore *Ubaldus* hath more exactly applyed the ſeveral Parts of it according to this Form, that the Point *A*, ſhould be as the common Fulciment, in which both the Sides do meet, and (as it were) uphold one another; the Points *B*, and *C*, repreſenting that part of the Leavers where the Weight is placed.

It is a general Rule, that the more acute the Angles of theſe Wedges are, by ſo much more eaſie will their Motion be; the Force being more eaſily impreſſed, and the Space wherein the Body is moved, being ſo much the leſs.

The ſecond Particular whereby this Faculty hath its force, is the *Manner* whereby the Power is impreſt upon it, which is by a Stroke or Blow; the Efficacy of which doth much exceed any other Strength. For tho' we ſuppoſe a Wedge being laid on a Piece of Timber, to be preſſed down with never ſo great a Weight; nay, tho' we ſhould apply unto it the Power of thoſe other Mechanical Engines, the Pulley, Screw, *&c.* yet the Effect would be ſcarce conſiderable in compariſon to that of a Blow. The true Reaſon of which, is one of the greateſt Subtilties in Nature, nor is it fully rendred by any of thoſe who have undertaken the Reſolution of it. * *Ariſtotle*, *Cardan*, and *Scaliger*, do generally aſcribe it unto the Swiftneſs of that Motion: But there ſeems

* *Mechan.* c. 10. *Subtil.* l. 17. *Exercit.* 331.

ſeems to be ſomething more in the Matter then ſo; for otherwiſe it would follow that the quick Stroke of a light Hammer ſhould be of greater Efficacy than any ſofter and more gentle Striking of a great Sledge. Or according to this, how ſhould it come to paſs, that the Force of an Arrow or Bullet diſcharged near at Hand (when the Impreſſion of that Violence whereby they are carried, is moſt freſh, and ſo in probability the Motion at its ſwifteſt) is yet notwithſtanding much leſs then it would be at a greater Diſtance. There is therefore further conſiderable, the Quality of that Inſtrument by which this Motion is given, and alſo the Conveniency of Diſtance thro' which it paſſes.

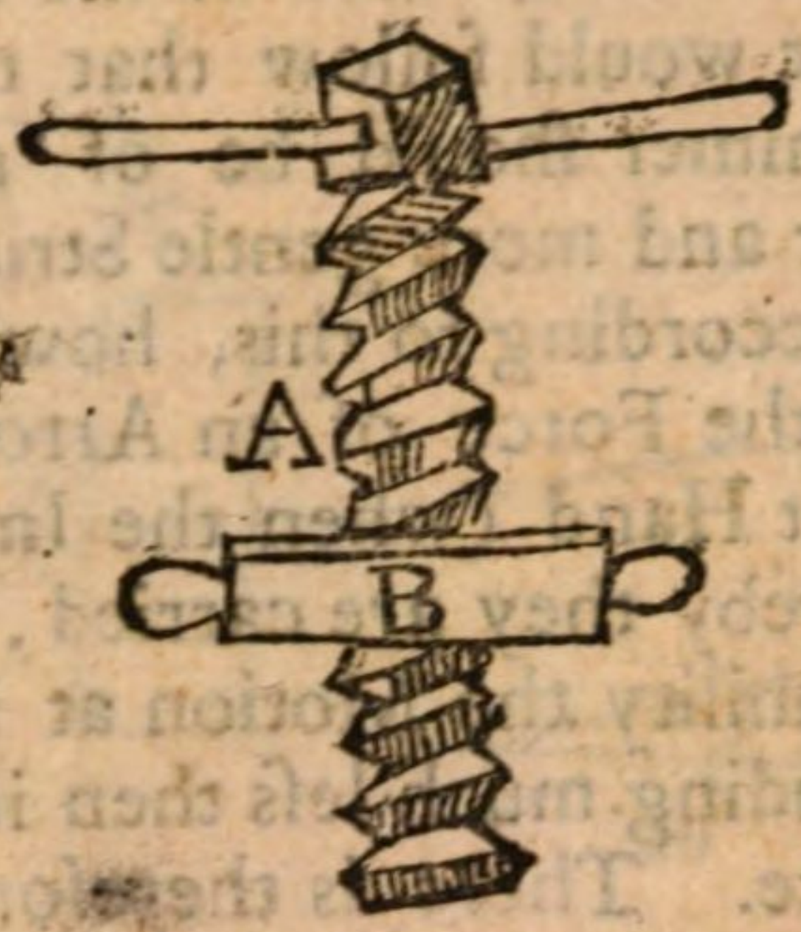
Unto this Faculty is uſually reduced the Force of Files, Saws, Hatchets, *&c.* which are as it were but ſo many Wedges faſtned unto a Vectis or Leaver.

CHAP. IX.

Of the Screw.

THAT which is uſually recited for the Sixth and laſt Mechanick Faculty, is the Screw, which is deſcribed to be a kind of Wedge that is multiplied, or continued by a helical Revolution about a Cylinder, receiving its Motion not from any Stroke, but from a Vectis at one End of it. It is uſually diſtinguiſhed into two ſeveral Kinds: The Male which is meant in the former Deſcription, and the Female which is of a concave Superficies. *Pappus Collect. Mathemat. l. 8.*

The



The former is noted in the Figure with the Letter *A*, the other with *F*.

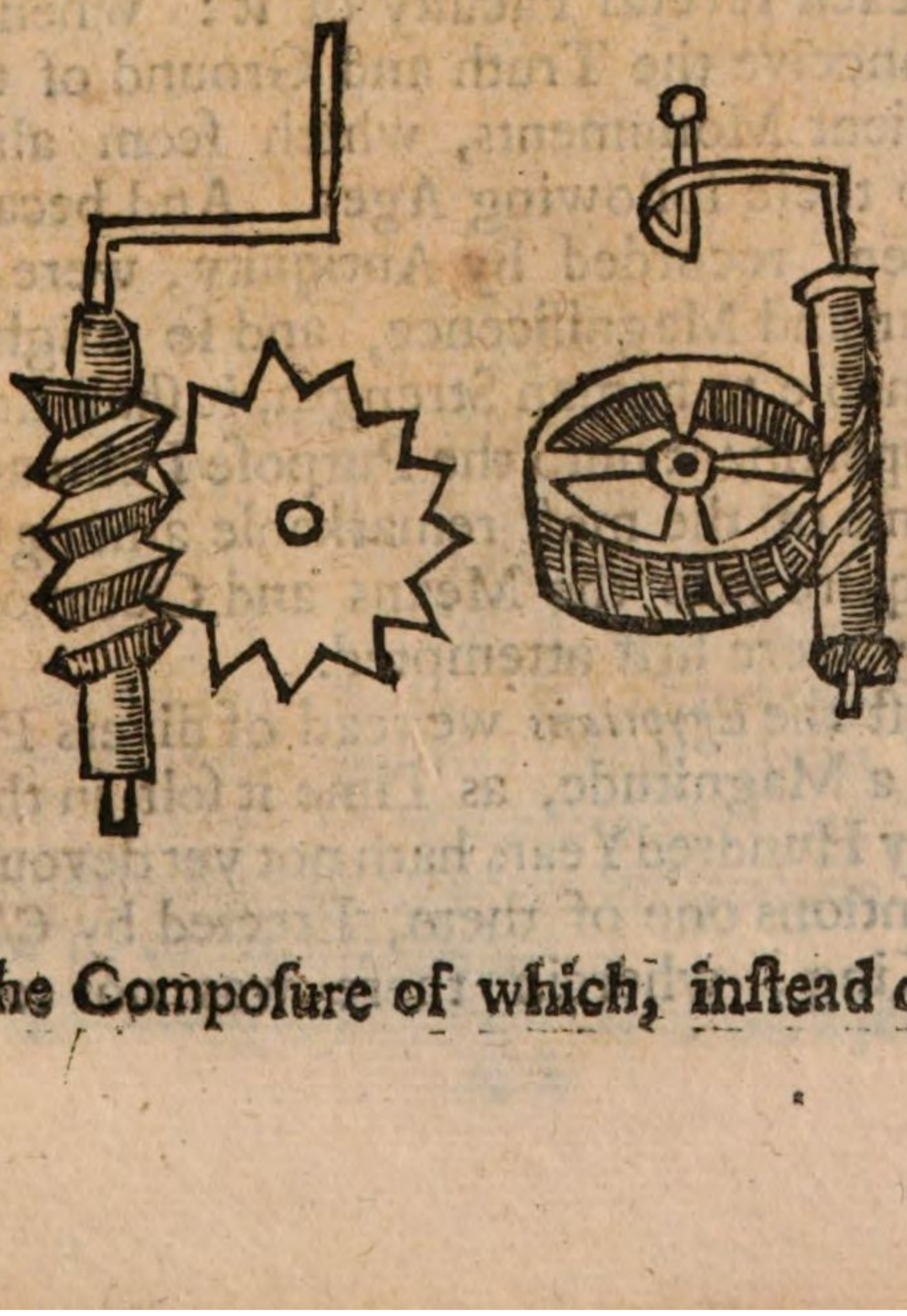
Ariſtotle himſelf doth not ſo much as mention this Inſtrument, which yet notwithſtanding is of greater Force and Subtilty than any of the reſt. It is chiefly applied to the Squeezing or Preſſing of things downwards, as in the Preſſes for Printing; for Wine, Oyl, and extracting the Juice from other Fruits. In the Performance of which, the Strength of one Man, may be of greater Force than the Weight of a heavy Mountain. It is likewiſe uſed for the Elevating or Lifting up of Weights.

The Advantage of this Faculty above the reſt, doth mainly conſiſt in this: The other Inſtruments do require ſo much Strength for the Supporting of the Weight to be moved, as may be equal unto it, beſides that other ſuperadded Power whereby it is out-weighed and moved; ſo that in the Operations by theſe, a Man does always ſpend himſelf in a continued Labour.

Thus (for Example) a Weight that is lifted up by a Wheel or Pulley, will of it ſelf deſcend, if there be not an equal Power to ſuſtain it. But now in the Compoſure of a Screw, this Inconvenience is perfectly remedied; for ſo much Force as is communicated

municated unto this Faculty from the Power that is applied unto it, is ſtill retained by the very Frame and Nature of the Inſtrument it ſelf; ſince the Motion of it cannot poſſibly return, but from the very ſame Place where it firſt began. Whence it comes to paſs, that any Weight lifted up with the Aſſiſtance of this Engine, may likewiſe be ſuſtained by it without the Help of any external Power; and cannot again deſcend unto its former Place, unleſs the handle of the Screw (where the Motion firſt began) be turned back: So that all the Strength of the Power may be employed in the Motion of the Weight, and none ſpent in the Suſtaining of it.

The chief Inconvenience of this Inſtrument is, that in a ſhort Space it will be ſcrewed unto its full length, and then it cannot be of any further Uſe for the Continuance of the Motion, unleſs it be returned back, and undone again as at the firſt. But this is uſually remedied by another Invention, commonly ſtyled a *perpetual Screw*, which hath the *Motion* of a *Wheel*, and the *Force* of a *Screw*, being both infinite.



For the Compoſure of which, inſtead of the Fe-

male

It is used in some Watches.

male, or concave Screw, there must be a little Wheel with some Notches in it, equivalent to Teeth, by which the other may take hold of it, and turn it round, as in these other Figures.

This latter Engine does so far exceed all other Contrivances to this purpose, that it may justly seem a Wonder why it is not of as common Use in these Times and Places, as any of the rest.

CHAP. X.

An Enquiry into the magnificent Works of the Ancients, which much exceeding our latter Times, may seem to infer a Decay in these Mechanical Arts.

THus have I briefly treated concerning the general Principles of Mechanicks, together with the distinct Proportions betwixt the Weight and the Power in each several Faculty of it: Whence it is easie to conceive the Truth and Ground of those famous Ancient Monuments, which seem almost incredible to these following Ages. And because many of them recorded by Antiquity, were of such vast Labour and Magnificence, and so mightily disproportionable to human Strength, it shall not therefore be impertinent unto the Purpose I aim at, for to specify some of the most remarkable amongst them, and to enquire into the Means and Occasion upon which they were first attempted.

Amongst the *Egyptians* we read of divers Pyramids of so vast a Magnitude, as Time it self in the Space of so many Hundred Years hath not yet devoured. *Herodotus* mentions one of them, Erected by *Cleopes* an *Egyptian* King, wherein there was not any one

Lib. 2. *c.* 175.

Stone

Stone less than 30 Foot long, all of them being fetched from *Arabia*. And not much after, the same Author relates, how *Amasis* another *Egyptian*, made himself a House of one entire Stone, which was 21 Cubits long, 14 broad, and 8 Cubits high. The same *Amasis* is reported to have made the Statue of a *Sphink*, or *Egyptian* Cat, all of one single Stone; whose Length was 143 Foot, its Height 62 Foot, the Compass of this Statue's Head containing 102 Foot. In one of the *Egyptian* Temples consecrated to *Jupiter*, there is related to be an *Obelisk*, consisting of 4 Smaragds or Emeralds; the whole is 40 Cubits high, 4 Cubits broad at the Bottom, and two at the Top. *Sesostris* the King of *Egypt*, in a Temple at *Memphis*, dedicated to *Vulcan*, is reported to have Erected two Statues; one for himself, the other for his Wife, both consisting of two several Stones, each of which were 30 Cubits high.

Plin. l. 36. c. 12.

Plin. l. 37. cap. 5.

Diodor. Sicul. Biblioth. l. 1. *Sect.* 2.

Amongst the *Jews* we read in Sacred Writ of *Solomon*'s Temple, which for its State and Magnificence, might have been justly reckoned amongst the other Wonders of the World; wherein besides the great Riches of the Materials, there were Works too of as great Labour. Pillars of Brass 18 Cubits high, and 12 Cubits round; great and costly Stones for the Foundation of it: *Josephus* tells us that some of them were 40 Cubits, others 45 Cubits long. And in the same Chapter he mentions the three famous Towers built by *Herod*; wherein every Stone being of white Marble, was 20 Cubits long, 10 broad, and 5 high. And which was the greatest Wonder, the old Wall it self was situated on a steep rising Ground, and yet the Hills upon it, on the Tops of which these Towers were placed, were about 30 Cubits high, that 'tis scarce imaginable by what Strength so many Stones of such great Magnitude should be conveyed to so high a Place.

1 King. 7. 15. c. 5. v. 17.

De bello Juda. l. 6. cap. 6.

Amongst the *Grecians* we read of the *Ephesian* Tem-

Plin. l. 36. cap. 14. *Pancirol. Deperd. Tit.* 32. ple dedicated to *Diana*; wherein there were 127 Columns made of so many several Stones, each of them 60 Foot high, being all taken out of the Quarries in *Asia*. 'Tis storied also of the Brazen *Colossus*, or great Statue in the Island of *Rhodes*, that it was 70 Cubits high. The Thumbs of it being so big that no Man could grasp one of them about with both his Arms; when it stood upright, a Ship might have passed betwixt the Legs of it, with all its Sails fully displayed; being thrown down by an Earthquake, the Brass of it did load 900 Camels. But above all Ancient Designs to this Purpose, that would have been most wonderful, which a *Grecian* Architect did propound unto *Alexander*, to cut the Mountain *Athos* into the Form of a Statue, which in his Right Hand should hold a Town capable of Ten thousand Men, and in his Left a Vessel to receive all the Water that flowed from the several Springs in the Mountain. But whether *Alexander* in his Ambition did fear that such an Idol should have more Honour than he himself, or whether in his good Husbandry, he thought that such a *Microcosm* (if I may so style it) would have cost him almost as much as the Conquering of this great World, or whatever else was the Reason, he refused to attempt it.

Plin. l. 34. cap. 3.

Vitruv. Archit. l. 2.

Suet. Ner. Amongst the *Romans* we read of a Brazen *Colossus*, made at the Command and Charges of *Nero*, which was 120 Foot high; *Martial* calls it *Sydereus*, or Starry.

Hic ubi Sydereus propius videt astra Colossus.

Pancirol. Deperd. Tit. 28. And it is storied of *M. Curio*, that he erected two *Theatres* sufficiently capacious of People, contrived moveable upon certain Hinges; sometimes there were several Plays and Shows in each of them, neither being any Disturbance to the other; and sometimes they were both turned about, with the People in them, and the Ends meeting together, did make a perfect *Amphitheatre*; So that the Spectators which were

were in either of them, might jointly behold the ſame Spectacles.

There were beſides at *Rome* ſundry *Obelisks*, made of ſo many entire Stones, ſome of them 40, ſome 80, and others 90 Cubits high. The chief of them were brought out of *Egypt*, where they were dug out of divers Quarries, and being wrought into Form, were afterwards (not without incredible Labour, and infinite Charges) conveyed unto *Rome*. In the Year 1586, there was erected an old *Obelisk* which had been formerly dedicated unto the Memory of *Julius Cæſar*. It was one ſolid Stone, being an Ophite or kind of ſpotted Marble. The Height of it was 107 Foot, the Breadth of it at the Bottom was 12 Foot, at the Top 8. Its whole Weight is reckoned to be 956148 Pounds; beſides the Heavineſs of all thoſe Inſtruments that were uſed about it, which (as it is thought) could not amount to leſs then 1042824 Pounds. It was tranſplaced at the Charges of Pope *Sixtus* the Fifth, from the left Side of the *Vatican* unto a more eminent Place about a hundred Foot off, where now it ſtands. The moving of this *Obelisk* is celebrated by the Writings of above 56 ſeveral Authors, (ſaith *Monantholius*) all of them mentioning it, not without much Wonder and Praiſe. Now if it ſeem ſo ſtrange and glorious an Attempt to move this *Obelisk* for ſo little a Space, what then may we think of the Carriage of it out of *Egypt*, and divers other far greater Works performed by Antiquity? This may ſeem to infer that theſe Mechanical Arts are now loſt, and decayed amongſt the many other Ruins of Time: Which yet notwithſtanding cannot be granted, without much Ingratitude to thoſe Learned Men, whoſe Labours in this kind we enjoy, and may juſtly boaſt of. And therefore for our better underſtanding of theſe Particulars, it will not be amiſs to enquire both *why*, and *how* ſuch Works ſhould be performed in thoſe former

Idem Tit. 31.

Comment. in Mechan. Ariſt. c. 19.

and ruder Ages, which *are not*, and (as it ſhould ſeem) *cannot* be effected in theſe later and more Learned Times. In the Examination of which, we ſhall find that it is not the want of Art that diſables us for them, ſince theſe Mechanical Diſcoveries are altogether as perfect, and (I think) much more exact now, than they were heretofore; but it is, becauſe we have not either the ſame *Motives* to attempt ſuch Works, or the ſame *Means* to effect them as the Ancients had.

CHAP. XI.

That the Ancients had divers Motives *and* Means *for ſuch vaſt Magnificent Works, which we have not.*

THE *Motives* by which they were excited to ſuch Magnificent Attempts, we may conceive to be chiefly Three:

Religion.
Policy.
Ambition.

1. *Religion.* Hence was it that moſt of theſe ſtately Buildings were intended for ſome Sacred Uſe, being either Temples or * Tombs, all of them Dedicated to ſome of their Deities. It was an inbred Principle in thoſe ancient Heathen, that they could not chuſe but merit very much by being liberal in their outward Services. And therefore we read of *Cræſus*, that being overcome in a Battel, and taken by *Cyrus*, he did revile the Gods of Ingratitude, becauſe they had no better Care of him, who had ſo frequently adored them with coſtly Oblations. And as they did conceive themſelves bound to part with their Lives in defence of their Religion,

* As Pyramids, Obelisks.

Herodot. l. 1.

ſo likewiſe to employ their utmoſt Power and Eſtate about any ſuch Deſign which might promote or advance it. Whereas now, the generality of Men, eſpecially the wiſeſt Sort amongſt them, are in this reſpect of another Opinion, counting ſuch great and immenſe Labours, to be at the beſt but Glorious Vanities. The Temple of *Solomon* indeed was to be a Type, and therefore it was neceſſary that it ſhould be ſo extraordinarily Magnificent, otherwiſe perhaps a much cheaper Structure might have been as commendable and ſerviceable.

2. *Policy.* That by this means they might find out Employment for the People, who of themſelves being not much civiliz'd, might by Idleneſs quickly grow to ſuch a Rudeneſs and Barbariſm, as not to be bounded within any Laws of Government. Again, by this Means the Riches of the Kingdom did not lie idlely in their Kings Treaſuries, but was always in Motion; which could not but be a great Advantage and Improvement to the Commonwealth. And perhaps ſome of them feared leſt if they ſhould leave too much Money unto their Succeſſors, it might be an occaſion to enſnare them in ſuch idle and vain Courſes, as would ruin their Kingdoms: Whereas in theſe latter Ages, none of all theſe politick Incitements can be of any force, becauſe now there is Employment enough for all, and Money little enough for every one. *Plin. l. 6. c. 12.*

3. *Ambition* to be known unto Poſterity; and hence likewiſe aroſe that incredible Labour and Care they beſtowed, to leave ſuch Monuments behind them as might * *continue for ever*, and make them famous unto all After-ages. This was the reaſon of *Abſalom*'s Pillar, ſpoken of in Scripture, *to keep his Name in remembrance.* And doubtleſs this too was the end which many other of the Ancients have aimed at, in thoſe (as they thought) everlaſting Buildings. Pſal. 49. 11. 2 Sam. 18. 18.

But now these later Ages are much more active and stirring; so that every ambitious Man may find so much Business for the present, that he shall scarce have any leisure to trouble himself about the future. And therefore in all these Respects, there is a great disproportion betwixt the Incitements of those former and these later times, unto such Magnificent Attempts.

Again, as they differ much in their *Motives* unto them, so likewise in the Means of effecting them.

There was formerly more Leisure and Opportunity, both for the Great Men to undertake such Works, and for the People to perfect them. Those past Ages were more quiet and peaceable, the Princes rather wanting Employment, than being over-press'd with it, and therefore were willing to make choice of such great Designs, about which to busy themselves. Whereas now the World is grown more politick, and therefore more troublesome; every Great Man having other private and necessary Business about which to employ both his Time and Means. And so likewise for the Common People, who then living more wildly, without being confined to particular Trades and Professions, might be more easily collected about such famous Employments; whereas now, if a Prince have any occasion for an Army, it is very hard for him to raise so great a Multitude as were usually employed about these Magnificent Buildings. We read of 360000 Men that were busied for Twenty Years in making one of
Lib. 2. the *Ægyptian* Pyramids. And *Herodotus* tells us of 1000000 Men who were as long in building another of them. About the Carriage of one Stone for *Amasis* the distance of twenty Days Journey, there was for Three Years together employed 2000 chosen Men, Governors, besides many other Under-Labourers. 'Twas the Opinion of * *Josephus* and *Nazianzen*, that these Pyramids were built by *Joseph* for
Antiq. l. 2. c. 5.

Grana-

Granaries againſt the Years of Famine. Others think that the Brick made by the Children of *Iſrael*, was employed about the framing of them, becauſe we read that the Tower of *Babel* did conſiſt of Brick or artificial Stone, *Gen.* 11. 3. And if theſe were the Labourers that were buſied about them, 'tis no wonder though they were of ſo vaſt a Magnitude; for we read that the Children of *Iſrael* at their coming out of *Ægypt*, were numbred to be Six hundred thouſand, and Three thouſand, and Five hundred and Fifty Men, *Numb.* 1. 46. So many handfuls of Earth would almoſt make a Mountain, and therefore we may eaſily believe that ſo great a Multitude in ſo long a ſpace as their Bondage laſted, for above four hundred Years, might well enough accompliſh ſuch vaſt Deſigns.

In the building of *Solomon*'s Temple, there were Threeſcore and Ten thouſand that bare Burdens, and Fourſcore thouſand Hewers in the Mountains, 1 *Kings* 5. 15.

The *Epheſian* Temple was built by all *Aſia* joyning together; the 127 Pillars were made by ſo many Kings, according to their ſeveral Succeſſions, the whole Work being not finiſhed under the ſpace of Two hundred and Fifteen Years. Whereas the tranſplacing of that Obelisk at *Rome* by *Sixtus* the Vth. (ſpoken of before) was done in ſome few Days by Five or Six hundred Men; and as the Work was much leſs than many other recorded by Antiquity, ſo the Means by which it was wrought, was yet far leſs in this reſpect than what is related of them.

2. The abundance of Wealth, which was then ingroſſed in the poſſeſſion of ſome few particular Perſons, being now diffuſed amongſt a far greater Number. There is now a greater equality amongſt Mankind, and the flouriſhing of Arts and Sciences hath ſo ſtirred up the Sparks of Men's natural Nobility, and made them of ſuch active and induſtri-

ous Spirits, as to free themſelves in a great meaſure from that Slavery, which thoſe former and wilder Nations were ſubjected unto.

In building one of the Pyramids, there was expended for the Maintenance of the Labourers with Radiſh and Onyons, no leſs than Eighteen hundred Talents, which is reckoned to amount unto 1880000 Crowns, or thereabouts. And conſidering the cheapneſs of theſe things in thoſe Times and Places, ſo much Money might go farther than a Sum ten times greater could do in the Maintenance of ſo many now.

In *Solomon*'s Temple we know how the extraordinary Riches of that King, the general flouriſhing of the whole State, and the Liberality of the People did jointly concur to the Building of the Temple. *De Bell. Jud. l. 6. cap. 6.* *Pecuniarum copia & populi largitas, majora dictu conabatur,* (ſaith *Joſephus.*) The *Rhodian Coloſſus* is reported to have coſt Three hundred Talents the making; and ſo were all thoſe other famous Monuments of proportionable Expence.

Pancirollus ſpeaking of thoſe Theatres that were erected at the Charges of ſome private *Roman* Citizens, ſaith thus: *Noſtro hoc ſæculo vel Rex ſatis haberet quod ageret ædificio ejuſmodi erigendo*; and a little after upon the like Occaſion, *Res mehercule miraculoſa, quæ noſtris temporibus vix à potentiſſimo aliquo rege poſſit exhiberi.* *Deperd. Tit. 18.*

3. Add unto the two former Conſiderations, that exact *Care* and indefatigable *Induſtry* which they beſtowed in the raiſing of thoſe Structures; theſe being the chief and only Deſigns on which many of them did employ all their beſt Thoughts and utmoſt Endeavours. *Cleopes* an *Ægyptian* King is reported to have been ſo deſirous to finiſh one of the Pyramids, that having ſpent all about it he was worth, or could poſſibly procure, he was forced at laſt to proſtitute his own Daughter for neceſſary Maintenance.

nance. And we read of *Ramiſes* another King of *Ægypt*, how that he was ſo careful to erect an Obelisk, about which he had employed 20000 Men, that when he feared leſt through the negligence of the Artificers, or weakneſs of the Engine, the Stone might fall and break, he tyed his own Son to the Top of it, that ſo the care of his Safety might make the Workmen more circumſpect in their Buſineſs. And what ſtrange Matters may be effected by the meer diligence and labour of great Multitudes, we may eaſily diſcern from the wild *Indians*, who having not the Art or Advantage of Engines, did yet by their unwearied Induſtry remove Stones of an incredible greatneſs. *Acoſta* relates that he himſelf meaſured one at *Tiaguanaco*, which was Thirty eight Foot long, Eighteen broad, and Six thick; and he affirms, that in their ſtatelieſt Ædifices there were many other of much vaſter Magnitude.

Plin. l. 36. c. 9.

Hiſtor. Ind. l. 6. c. 14.

From all which Conſiderations, it may appear, that the ſtrangeneſs of thoſe ancient Monuments above any that are now effected, does not neceſſarily infer any defect of Art in theſe later Ages. And I conceive, it were as eaſie to demonſtrate the Mechanical Arts in theſe times to be ſo far beyond the knowledge of former Ages, that had we but the ſame Means as the Ancients had, we might effect far greater Matters than any they attempted, and that too in a ſhorter ſpace, and with leſs Labour.

CHAP.

CHAP. XII.

Concerning the Force of the Mechanick Faculties; particularly the Balance and Leaver. How they may be contrived to move the whole World, or any conceivable Weight.

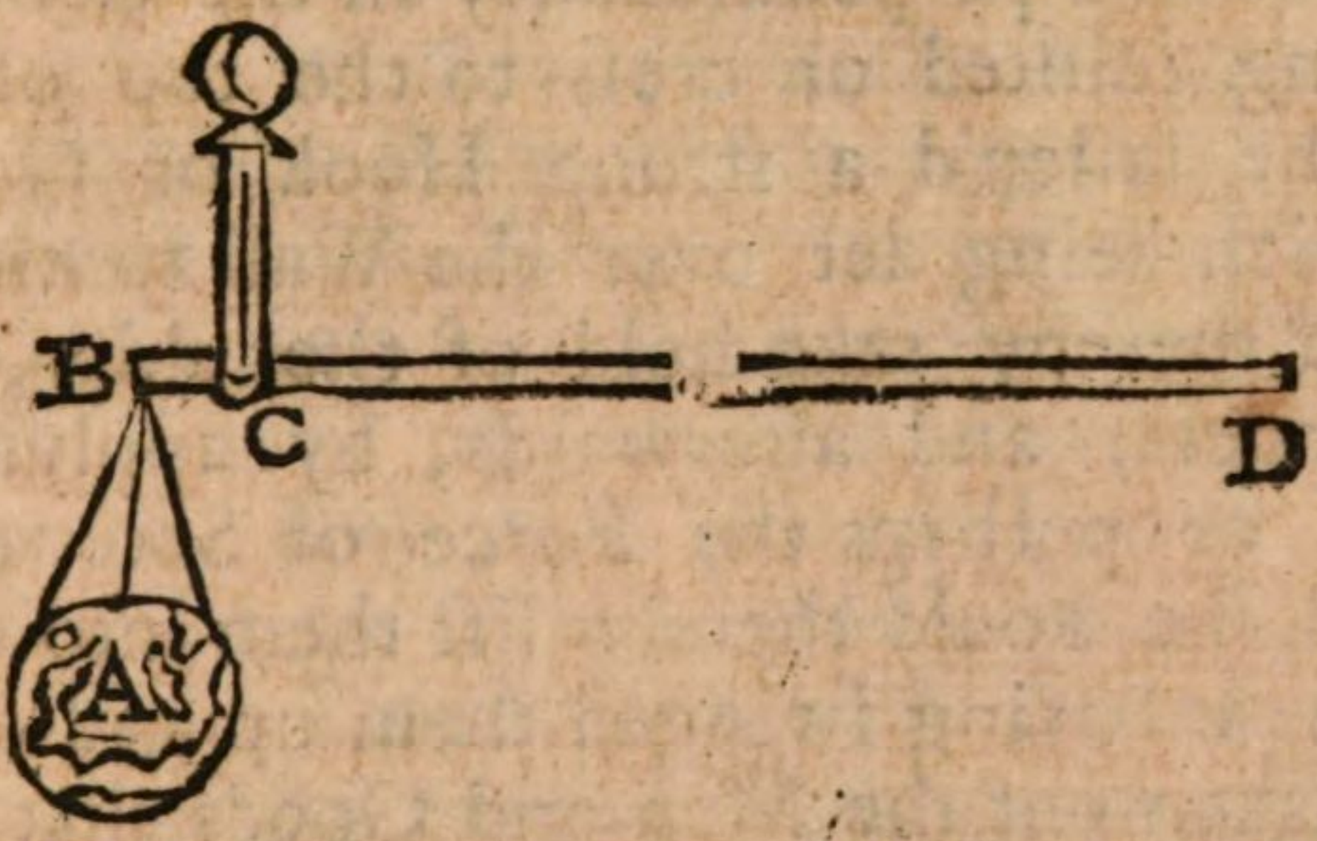
ALL these Magnificent Works of the Ancients before specify'd, are scarce considerable in respect of Art, if we compare them with the famous Speeches and Acts of *Archimedes*: Of whom it is reported, that he was frequently wont to say, how that he could move *Datum pondus, cum data potentiâ*; the greatest conceivable Weight, with the least conceivable Power: And that if he did but know where to stand and fasten his Instrument, he could move the World, all this great Globe of Sea and Land. Which *Promises*, tho' they were altogether above the vulgar Apprehension or Belief, yet because his Acts were somewhat answerable thereunto, therefore the King of *Syracuse* did enact a Law, whereby every man was bound to believe whatever *Archimedes* would affirm.

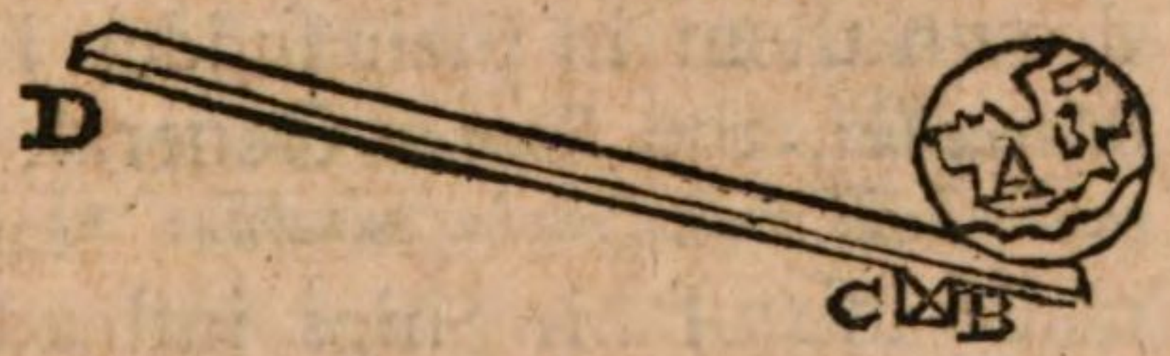
'Tis easy to demonstrate the Geometrical Truth of those strange Assertions, by examining them according to each of the forenamed *Mechanick* Faculties, every one of which is of infinite Power.

To begin with the two first of them, the Balance and the Leaver, (which I here join together, because the Proportions of both are wholly alike;) 'tis certain, tho' there should be the greatest imaginable Weight, and the least imaginable Power, (suppose the whole World, and the Strength of one Man, or Infant;) yet if we conceive the same Disproportion betwixt their several Distances in the former Faculties, from the Fulciment, or Center of Gravity, they would both equiponderate. And if

the

the Distance of the Power from the Center, in comparison to the Distance of the Weight, were but any thing more than the Heaviness of the Weight is in respect of the Power, it may then be evident from the former Principles, that the Power would be of greater Force than the Weight, and consequently able to move it.





Thus, if we suppose this great Globe at *A* to contain 240000000000000000000000 Pounds, allowing a Hundred Pound for each Cubical Foot in it, (as *Stevinius* hath calculated) yet a Man or Child at *D*, whose Strength perhaps is but equivalent to One hundred, or Ten Pounds Weight, may be able to outweigh and move it; if there be but a little greater Disproportion betwixt the two Distances *C D* and *C B*, than there is betwixt the Heaviness of the Weight, and the Strength of the Power; that is, if the Distance *C D*, unto the other Distance *C B*, be any thing more than 240000000000000000000000 unto 100 or 10, every *Static. l.* 3. *prop.* 10.

ry ordinary Inſtrument doth include all theſe Parts *really*, tho' not ſenſibly diſtinguiſhed.

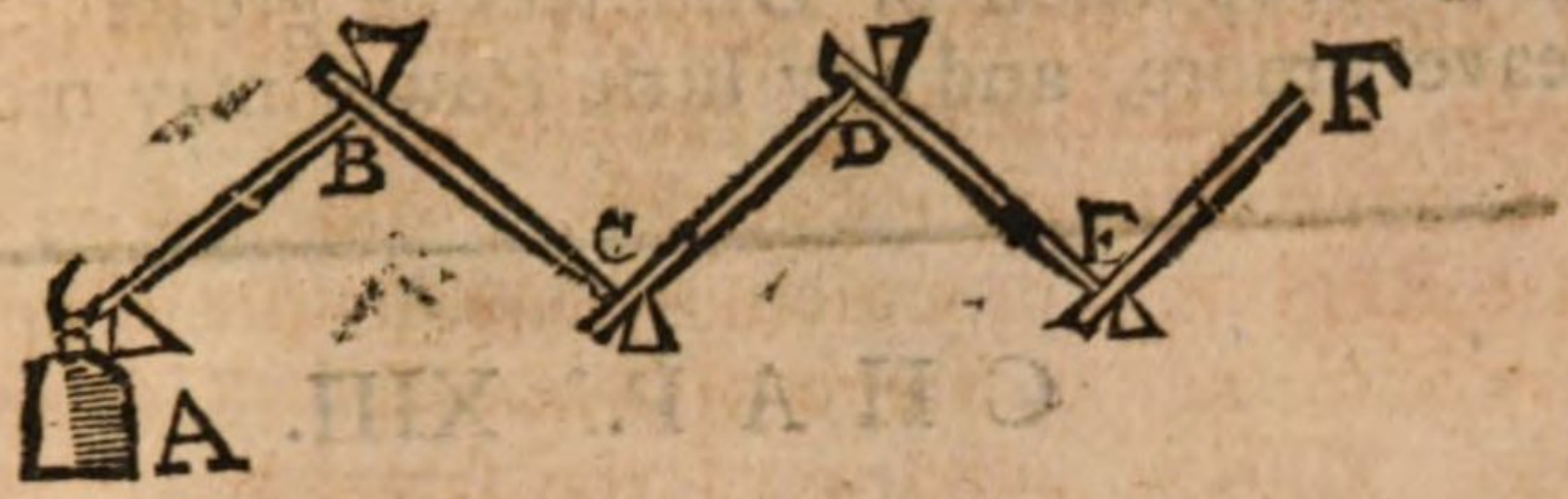
Under this latter Faculty, I did before mention that Engine, by which *Archimedes* drew up the *Roman* Ships at the Siege of *Syracuſe*. This is uſually ſtiled *Tollenon*, being of the ſame Form with that which is commonly uſed by Brewers and Dyers, for the drawing of Water. It conſiſts of two Poſts; the one faſten'd perpendicularly in the Ground, the other being jointed on croſs to the top of it. At the end he faſten'd a ſtrong Hook or Grapple of Iron, which being let over the Wall to the River, he would thereby take hold of the Ships, as they paſſed under; and afterwards, by applying ſome Weight, or perhaps the Force of Screws to the other end, he would thereby lift them into the open Air; where having ſwinged them up and down till he had ſhaken out the Men and Goods that were in them, he would then daſh the Veſſels againſt the Rocks, or drown them in their ſudden Fall: Inſomuch that *Marcellus*, the *Roman* General, was wont to ſay, Τὸ μὲν νεωτὸν αὐτῷ χωλαίζειν ὑπὸ θαλάττης Ἀρχιμήδη, That *Archimedes* made uſe of his Ships inſtead of Buckets to draw Water with.

Lipſius Poliorcet. l.1. Dialog.6.

Plutarch in his Life.

This Faculty will be of the ſame Force, not only when it is continued in one, but alſo when it is multiplied in divers Inſtruments; as may be conceived in this other Form; which I do not mention, as if it could be ſerviceable for any other Motion, (ſince the Space by which the Weight would be moved, will be ſo little as not to fall under Senſe) but only for the better Explication of this Mechanick Principle, and for the right underſtanding of that Force ariſing from Multiplication in the other Faculties, which do all depend upon this. The Wheel, and Pulley, and Screw, being but as ſo many Leavers of a Circular Form and Motion, whoſe Strength may be therefore continued to a greater Space.

Imagine



Imagine the Weight *A* to be a Hundred thouſand Pounds, and the Diſtance of that Point, wherein every Leaver touches either the Weight, or one another from the Point where they touch the Prop, to be but one ſuch Part, whereof the Remainder contains ten; then according to the former Grounds, 10000 at *B* will equiponderate to *A*, which is 100000; ſo that the ſecond Leaver hath but 10000 Pounds to move. Now, becauſe this obſerves the ſame Proportions with the other, in the Diſtances of its ſeveral Points, therefore 1000 Pounds at *C* will be of equal Weight to the former: And the Weight at *C* being but as a Thouſand Pound, that which is but as a Hundred at *D*, will be anſwerable unto it; and ſo ſtill in the ſame Proportion, that which is but 10 at *E*, will be equal to 100 at *D*; and that which is but one Pound at *F*, will alſo be equal to ten at *E*. Whence it is manifeſt, that one Pound at *F* is equal to 100000 at *A*; and the Weight muſt always be diminiſhed in the ſame Proportion as ten to one, becauſe in the multiplication of theſe Leavers, the Diſtance of the Point where the Inſtrument touches the Weight, from that where it touches the Prop, is but as one ſuch Part, whereof the Remainder contains ten. But now if we imagine it to be as the Thouſandth Part, then muſt the Weight be diminiſhed according to this Proportion; and then in the ſame multiplication of Leavers, 1 Pound will be equal to 1000 000 000 000 000 Pounds: So that tho' we

ſuppoſe

ſuppoſe the Weight to be never ſo heavy, yet let the Diſproportion of Diſtances be greater, or the Leavers more, and any little Power may move it.

CHAP. XIII.

Of the Wheel: By Multiplication of which, it is eaſy to move any imaginable Weight.

THE Wheel, or *Axis in Peritrochio*, was before demonſtrated to be of equivalent Force with the former Faculties. If we conceive the ſame Difference betwixt the Semidiameter of the Wheels, or Spokes *A C*, and the Semidiameter of the *Axis A B*, as there is betwixt the Weight of the World, and the Strength of a Man; it may then be evident, that this Strength of one Man, by the help of ſuch an Inſtrument, will equiponderate to the Weight of the whole World. And if the Semidiameter of the Wheel *A C*, be but any thing more in reſpect of the Semidiameter of the *Axis A B*, than the Weight of the World ſuppoſed at *D*, is in compariſon to the Strength of a Man at *C*; it may then be manifeſt from the ſame Grounds, that this Strength will be of ſo much greater Force than the Weight, and conſequently able to move it.

See the figure, *c.* 6.

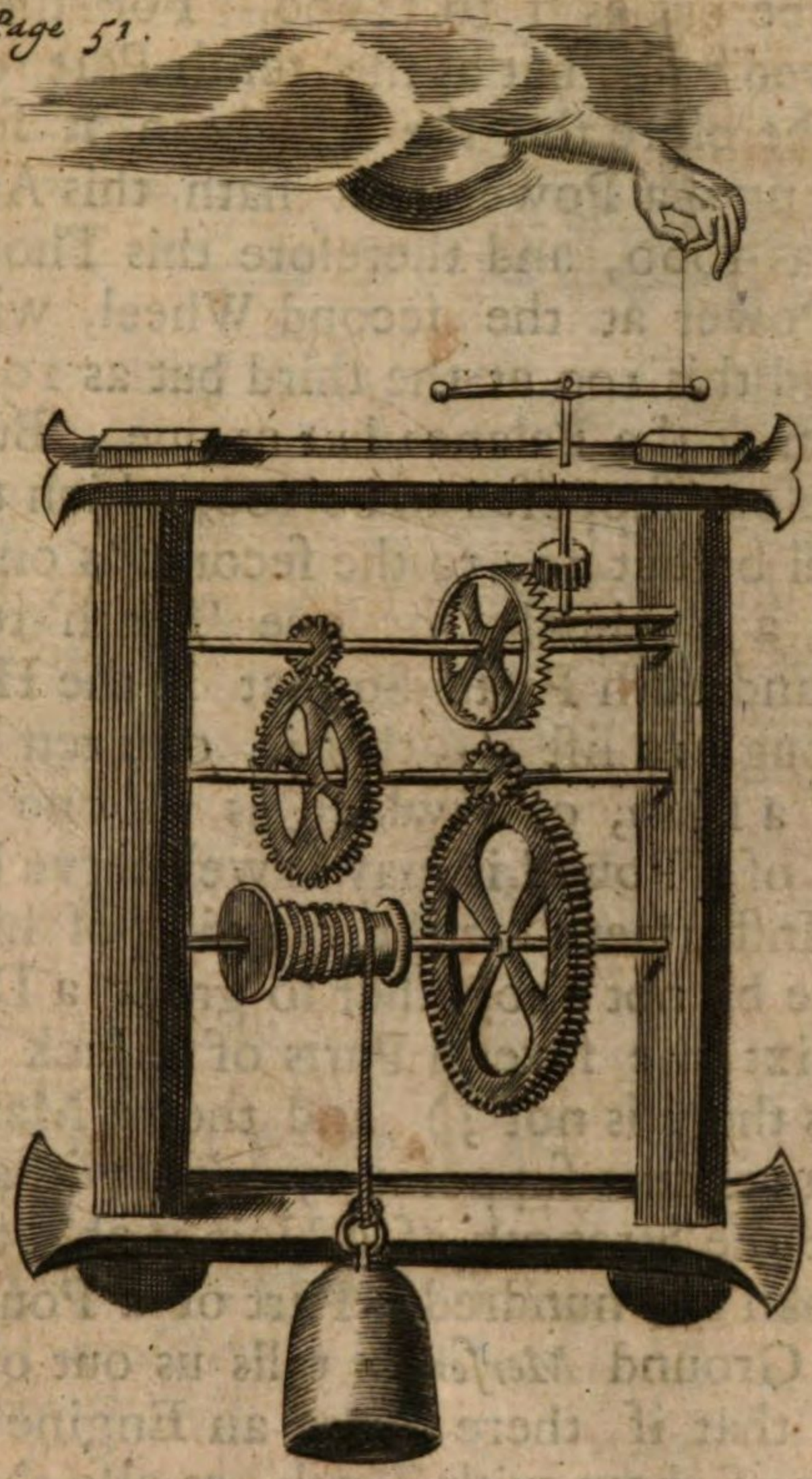
An Engine of many Wheels is commonly called *Gloſſocomus*.

The Force of this Faculty may be more conveniently underſtood and uſed by the Multiplication of ſeveral Wheels, together with Nuts belonging unto each of them; as it may be eaſily experimented in the ordinary Jacks that are uſed for the roaſting of Meat, which commonly conſiſt but of three Wheels; and yet if we ſuppoſe a Man ty'd in the place of the Weight, it were eaſy by a ſingle Hair faſtned unto the Fly or Balance of the Jack, to draw him up from the Ground: As will be evident from this following Figure.

How to pull a man above Ground with a ſingle Hair.

Where

Page 51.



Where ſuppoſe the Length of the Fly or Balance in compariſon to the Breadth of its Axis, to be as 10 to one, and ſo for the three other Wheels in reſpect of the Nuts that belong unto them; (tho' this Difference be oftentimes leſs, as we may well allow it to be); withal ſuppoſe the Weight (or a Man tied in the Place of it) to be a hundred Pounds: I ſay according to this Suppoſition, it is evident that the

Power

Power at the Balance which ſhall be equal to the Weight, need be but as 1 to 10000. For the firſt Axis is conceived to be but as the tenth Part of its Wheel; and therefore tho' the Weight in it ſelf be as 10000, yet unto a Power that hath this Advantage, it is but as 1000, and therefore this Thouſand unto the like Power at the ſecond Wheel, will be but as 100, and this 100 at the third but as 10; and laſtly, this Ten at the Balance but as one. But the Weight was before ſuppoſed to be 100, which to the firſt Wheel will be but 10, to the ſecond as one, to the third as a decimal, or one Tenth to the Sails as one hundredth Part: So that if the Hair be but ſtrong enough to lift $\frac{1}{10000}$ that is, one ten thouſandth Part of a Man, or (which is all one) one hundreth Part of a Pound, it may as well ſerve by the Help of this Inſtrument for the drawing of him up. And tho' there be not altogether ſo great a Diſproportion betwixt the ſeveral Parts of a Jack (as in many perhaps there is not;) and tho' a Man may be heavier than is here ſuppoſed, yet 'tis withal conſiderable, that the Strength of a Hair is able to bear much more than the hundredth Part of a Pound.

Comment. in Gen. c. 1. v. 10. art. 6. De viribus motricibus Theor. 16.

Upon this Ground *Merſennus* tells us out of *Solomon de Cavet*, that if there were an Engine of 12 Wheels, each of them with Teeth, as alſo the Axes or Nuts that belong unto them; if the Diameter of theſe Wheels were unto each *Axis*, as a hundred to one; and if we ſuppoſe theſe Wheels to be ſo placed, that the Teeth of the one might take hold of the *Axis* that belongs unto the next, and that the *Axis* of the Handle may turn the firſt Wheel, and the Weight be tied unto the Axis of the laſt; with ſuch an Engine as this, ſaith he, a Child (if he could ſtand any where without this Earth) might with much eaſe move it towards him.

For

For according to the former Supposition, that this Globe of Sea and Land did contain as many hnndred Pounds as it doth Cubical Feet, *viz.* 240000000000000000000000, it may be evident that any Strength, whose Force is but equivalent to 3 Pounds, will by such an Engine be able to move it.

Of this kind was that Engine so highly extolled by *Stevinus*, which he calls *Pancration*, or *Omnipotent*, preferring it before the Inventions of *Archimedes*. It consisted of Wheels and Nuts, as that before specified is supposed. Hither also should be referred the Force of Racks, which serve for bending of the strongest Bows, as also that little Pocket Engine, wherewith a Man may break or wrench open any Door, together with divers the like Instruments in common Use.

De Statica praxi.

Ramelli Fig. 160.

CHAP. XIV.

Concerning the infinite Strength of Wheels, Pulleys, and Screws. That it is possible by the Multiplication of these, to pull up any Oak by the Roots with a Hair, lift it up with a Straw, or blow it up with ones Breath, or to perform the greatest Labour with the least Power.

FRom what hath been before delivered concerning the Nature of the Pulley, it is easie to understand how this Faculty also may be proportioned betwixt any Weight, and any Power, as being likewise of infinite Strength.

'Tis reported of *Archimedes*, that with an Engine of Pulleys, to which he applied only his Left Hand, he lifted up * 5000 Bushels of Corn at once, and

* 7000 saith *Zetzes Chiliad.* 2. *Hist.* 35.

drew a Ship with all its Lading upon dry Land. This Engine *Zetzes* calls *Trispatum*, or *Trispastum*, which signifies only a threefold Pulley: But herein he doth evidently mistake, for 'tis not possible that this alone should serve for the Motion of so great a Weight; because such an Engine can but make a Subsextuple, or at most a Subseptuple Proportion betwixt the Weight and Power; which is much too little to reconcile the Strength of a Man unto so much Heaviness. Therefore *Ubaldus* doth more properly style it, *Polyspaston*; or an Instrument of many Pulleys. How many, were easie to find out, if we did exactly know the Weight of those Ancient Measures; supposing them to be the same with our Bushel in *England*, which contains 64 Pints or Pounds, the whole would amount to 320000 Pounds; half of which would be lightned by the Help of one Pulley, Three Quarters by two Pulleys, and so onward, according to this Subduple, Subquadruple, and Subsextuple Proportion. So that if we conceive the Strength of the Left Hand to be equivalent unto 20 or 40 Pounds, it is easie to find out how many Pulleys are required to enable it for the Motion of so great a Weight.

Præf. ad Mechan.

Comment. in Gen. c. 1. v. 10. art. 6.

Upon this Ground *Mersennus* tells us, that any little Child with an Engine of an hundred double Pulleys, might easily move this Great Globe of Earth, tho' it were much heavier than it is. And in reference to this kind of Engine (saith *Monantholius*) are we to understand that Assertion of *Archimedes*, (as he more immediately intended it) concerning the Possibility of moving the World.

Præf. ad Mechan.

Aristotle.

The Wedge was before demonstrated to be as a double Vectis or Leaver, and therefore it would be needless to explain particularly how this likewise may be contrived of infinite Force.

The Screw is capable of Multiplication, as well

as

as any of the other Faculties, and may perhaps be more ſerviceable for ſuch great Weights, than any of the reſt. *Archimedes* his Engine of greateſt Strength, called *Cariſtion*, is by ſome thought to conſiſt of theſe: *Axes habebat cum infinitis Cochleis.* And that other Engine of his called *Helix*, (mentioned by * *Athenæus*) wherewith he lifted *Hiero*'s great Ship into the Sea, without any other Help, is moſt likely to be framed of perpetual Screws, ſaith *Rivaltus*.

Stevin. de Static. prax.

See *Beſſon.*

* *Deipnoſophiſt. l.* 5.

Oper. exter. Archimed.

Whence it may evidently appear, that each of theſe Mechanick Faculties are of infinite power, and may be contrived proportionable unto any conceivable Weight. And that no natural Strength is any way comparable unto theſe artificial Inventions.

'Tis reported of *Sampſon*, that he could carry the Gates of a City upon his Shoulders; and that the ſtrongeſt Bonds were unto him but as Flax burnt with Fire, and yet his Hair being ſhaved off, all his Strength departed from him. We * read of *Milo* that he could carry an Ox upon his Back, and yet when he tried to tear an Oak aſunder that was ſomewhat riven before, having drawn it to its utmoſt, it ſuddenly joined together again, catching his Hands in the Cleft, and ſo ſtrongly manacled him, that he became a Prey to the wild Beaſts.

Judg. 15.

* *A. Gell. Noct. Att. l.* 15. *c.* 16.

But now by theſe Mechanical Contrivances, it were eaſy to have made one of *Sampſon*'s Hairs that was ſhaved off, to have been of more Strength than all of them when they were on. By the Help of theſe Arts it is poſſible (as I ſhall demonſtrate) for any Man to lift up the greateſt Oak by the Roots with a Straw, to pull it up with a Hair, or to blow it up with his Breath.

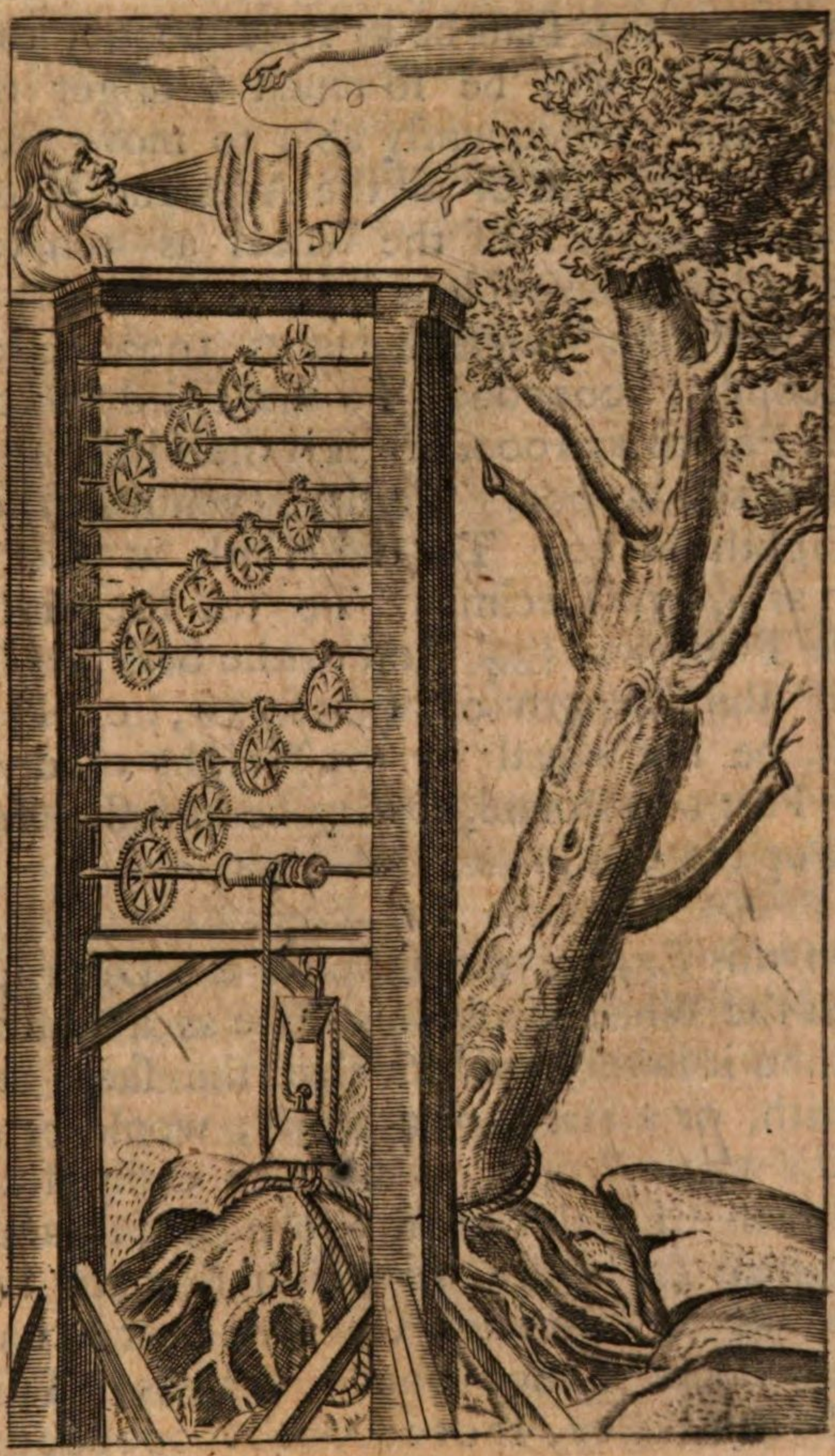
Suppoſe the Roots of an Oak to extend a thouſand Foot Square, (which is almoſt a Quarter of a Mile) and Forty Foot deep, each Cubical Foot being an

hundred Pound Weight; which tho' it be much beyond the Extenſion of any Tree, or the Weight of Earth; the Compaſs of the Roots in the Ground (according to common Opinion) not extending further than the Branches of it in the Air, and the Depth of it not above ten Foot, beyond which the greateſt Rain doth not penetrate (ſaith * *Seneca.*) *Ego vinearum diligens foſſor affirmo nullam pluviam eſſe tam magnam, quæ terram ultra decem pedes in altitudinem madefaciat.* And becauſe the Root muſt receive its nouriſhment from the Help of Showers, therefore it is probable that it doth not go below them. So that (I ſay) tho' the Proportions ſuppoſed do much exceed the real Truth, yet it is conſiderable that ſome great Overplus muſt be allowed for that Labour which there will be in the forcible Divulſion or Separation of the Parts of the Earth which are continued.

* *Nat. Qu. l. 3. c. 7.*

According to this Suppoſition, the Work of forcing up the Oak by the Roots, will be equivalent to the lifting up of 400000000 Pound Weight, which by the Advantage of ſuch an Engine, as is here deſcribed, may be eaſily performed with the leaſt conceivable Power.

The



The whole Force of this Engine doth conſiſt in two double Pulleys, twelve Wheels, and a Sail. One of theſe Pulleys at the Bottom will diminiſh half of the Weight, ſo that it ſhall be but as 2000000000, and the other Pulley will abate ¾ three quarters of it; ſo that it ſhall be but as 1000000000. And becauſe the Beginning of the String being faſt-

ned unto the lower Pulley, makes the Power to be in a ſubquintuple Proportion unto the Weight, therefore a Power that ſhall be as 1000000000, that is, a Subquadruple, will be ſo much ſtronger than the Weight, and conſequently able to move it. Now ſuppoſe the Breadth of all the Axes and Nuts to be unto the Diameters of the Wheel as ten to one; and it will then be evident that to a Power at the Firſt Wheel, the Weight is but as 100000000. To the Second as 10000000. To the Third as 1000000. To the Fourth as 100000. To the Fifth as 10000. To the Sixth as 1000. To the Seventh as 100. To the Eighth as 10. To the Ninth as 1. To the Tenth as $\frac{1}{10}$, one Decimal. To the Eleventh as $\frac{1}{1000}$. To the Twelfth as $\frac{1}{10000}$. And to the Sails yet leſs. So that if the Strength of the Straw, or Hair, or Breath, be but equal to the Weight of one thouſandth Part of a Pound, it may be of ſufficient Force to pull up the Oak.

See ch. 7.

If in this Engine we ſuppoſe the Diſproportion betwixt the Wheels and Nuts to be as a hundred to one, then it is very evident that the ſame Strength of Breath, or a Hair, or a Straw, would be able to move the whole World, as will be eaſily found by Calculation. Let this great Globe of Sea and Land be imagined (as before) to weigh ſo many hundred Pounds as it contains Cubical Feet; namely, 240000000000000000000000 Pounds. This will be to the firſt Pulley, 120000000000000000000000000. To the 2d leſs than 600000000000000000000000000. But for more eaſie and convenient reckoning, let it be ſuppoſed to be ſomewhat more, *viz.* 1000000000000000000000000000. This to the firſt Wheel

Wheel will be but as	1000000000000000000000.
To the Second as	100000000000000000000.
To the Third as	10000000000000000000.
To the Fourth as	1000000000000000.
To the Fifth	100000000000000.
To the Sixth	10000000000000.
To the Seventh	1000000000.
To the Eighth	100000000.
To the Ninth	1000000.
To the Tenth	10000.
To the Eleventh	100.
To the Twelfth	1.
To the Sails as	$\frac{1}{100}$.

So that a Power which is much leſs than the hundredth Part of a Pound will be able to move the World.

It were needleſs to ſet down any particular Explication, how ſuch Mechanical Strength may be applied unto all the Kinds of local Motion; ſince this in it ſelf is ſo facil and obvious, that every ordinary Artificer doth ſufficiently underſtand it.

The Species of local violent Motion are by *Ariſtotle* reckoned to be theſe Four: *Phyſ. l. 7. c. 3.*

Pulſio.
Tractio.
Vectio.
Vertigo.

Thruſting, Drawing, Carrying, Turning. Unto ſome of which all theſe Artificial Operations muſt neceſſarily be reduced, the Strength of any Power being equally appliable unto all of them: So that there is no Work impoſſible to theſe Contrivances; but there may be as much acted by this Art, as can be fancied by Imagination.

CHAP. XV.

Concerning the Proportion of Slowneſs and Swiftneſs in Mechanical Motions.

HAving already diſcourſed concerning the Strength of theſe Mechanical Faculties; it remains for the more perfect Diſcovery of their Natures, that we treat ſomewhat concerning thoſe two Differences of Artificial Motion:

{ Slowneſs, and Swiftneſs.

Without the right underſtanding of which, a Man ſhall be expoſed to many abſurd Miſtakes, in attempting of thoſe Things which are either in themſelves impoſſible, or elſe not to be performed with ſuch Means as are apply'd unto them. I may ſafely affirm, that many, if not moſt Miſtakes in theſe Mechanical Deſigns, do ariſe from a Miſapprehenſion of that Difference which there will be betwixt the Slowneſs or Swiftneſs of the Weight and Power, in compariſon to the Proportion of their ſeveral Strengths.

Hence it is, that ſo many Engines invented for Mines and Water-works, do ſo often fail in the Performance of that for which they were intended; becauſe the Artificers many times do forget to allow ſo much time for the working of their Engine, as may be proportionable to the Difference betwixt the Weight and Power that belong unto them: Whereas, he that rightly underſtands the Grounds of this Art, may as eaſily find out the Difference

ference of Space and Time required to the Motion of the Weight and Power, as he may their different Strengths; and not only tell how any Power may move any Weight, but alſo in what a Space of *Time* it may move it any Space or *Diſtance*.

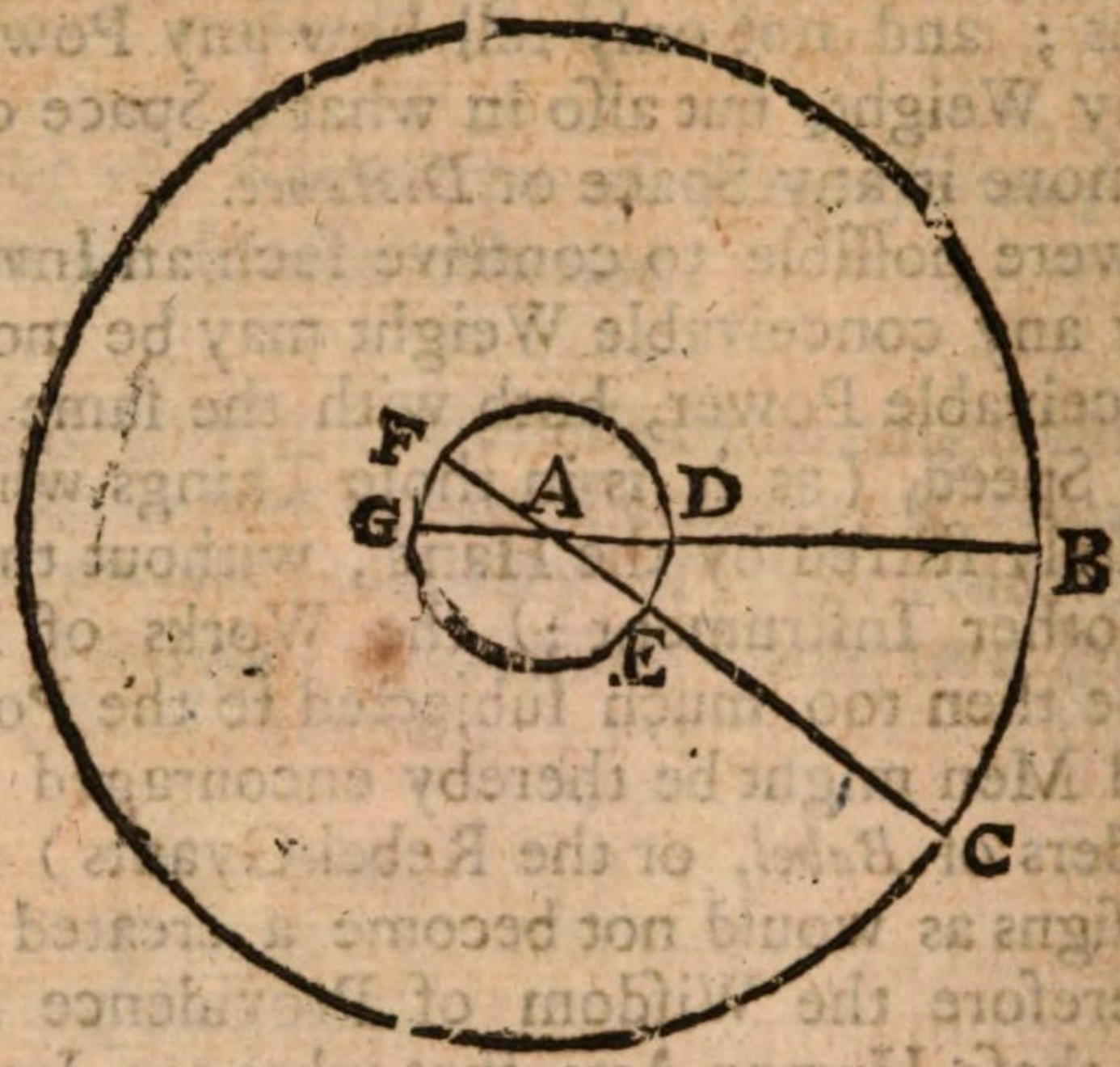
If it were poſſible to contrive ſuch an Invention, whereby any conceivable Weight may be moved by any conceivable Power, both with the ſame Quickneſs and Speed, (as it is in thoſe Things which are immediately ſtirred by the Hand, without the Help of any other Inſtrument;) the Works of Nature would be then too much ſubjected to the Power of Art, and Men might be thereby encouraged (with the Builders of *Babel*, or the Rebel Gyants) to ſuch bold Deſigns as would not become a created Being. And therefore the Wiſdom of Providence hath ſo confined theſe Human Arts, that what any Invention hath in the *Strength* of its Motion, is abated in the *Slowneſs* of it; and what it hath in the extraordinary *Quickneſs* of its Motion, muſt be allowed for in the great *Strength* that is required unto it.

For it is to be obſerved as a general Rule, that the Space of Time or Place, in which the Weight is moved, in compariſon to that in which the Power doth move, is in the ſame Proportion as they themſelves are unto one another.

So that if there be any great Difference betwixt the Strength of the Weight and the Power, the ſame kind of Differences will there be in the Spaces of their Motion.

To illuſtrate this by an Example:

Let



Let the Line *G A B* repreſent a Balance, or Leaver; the Weight being ſuppoſed at the Point *G*, the Fulciment at *A*, and the Power ſuſtaining the Weight at *B*. Suppoſe the Point *G*, unto which the Weight is faſtned, to be elevated unto *F*, and the oppoſite Point *B* to be depreſſed unto *C*; 'tis evident that the Arch *F G*, or (which is all one) *D E*, doth ſhew the Space of the Weight, and the Arch *B C* the Motion of the Power. Now both theſe Arches have the ſame Proportion unto one another, as there is betwixt the Weight and the Power, or (which is all one) as there is betwixt their ſeveral Diſtances from the Fulciment. Suppoſe *A G* unto *A B* to be as one unto four; it may then be evident, that *F G*, or *D E*, will be in the ſame Proportion unto *B C*: For as any two Semidiameters are unto one another, ſo are the ſeveral Circumferences deſcribed by them, as alſo any proportional Parts of the ſame Circumferences.

And as the Weight and Power do thus differ in the Spaces of their Motions, ſo likewiſe in the Slow-

neſs

neſs of it; the one moving the whole Diſtance *B C*, in the ſame time wherein the other paſſes only *G F*. So that the Motion of the Power from *B* to *C*, is four times ſwifter than that of the Weight from *G* to *F*. And thus will it be, if we ſuppoſe the Diſproportions to be far greater; whether or no we conceive it, either by a *Continuation* of the ſame Inſtrument and Faculty, as in the former Example; or by a *Multiplication* of divers, as in Pulleys, Wheels, *&c.* By how much the Power is in it ſelf leſs than the Weight, by ſo much will the Motion of the Weight be ſlower than that of the Power.

To this purpoſe, I ſhall briefly touch at one of the Diagrams expreſſed before in the Twelfth Chapter, concerning the Multiplication of Leavers.

In which, as each Inſtrument doth diminiſh the Weight according to a decuple Proportion, ſo alſo do they diminiſh the *Space* and *Slowneſs* of its Motion. For if we ſhould conceive the firſt Leaver *B* to be depreſſed unto its loweſt, ſuppoſe ten Foot, yet the Weight *A* would not be raiſed above one Foot: But now the ſecond Leaver, at its utmoſt, could move but a Tenth Part of the firſt, and the third Leaver but a Tenth Part of the ſecond; and ſo of the reſt. So that the laſt Leaver *F* being depreſſed, will paſs a *Space* 100000 greater, and by a Motion, 100000 ſwifter than the Weight at *A*.

Thus are we to conceive of all the other Faculties, wherein there is conſtantly the ſame Diſpro-

portion

portion betwixt the Weight and Power, in respect of the Spaces and Slowness of their Motions, as there is betwixt their several Gravities. If the Power be unto the Weight but as One unto a Hundred, then the Space through which the Weight moves, will be a hundred times less, and consequently the Motion of the Weight a hundred times slower than that of the Power.

So that it is but a vain and impossible Fancy for any one to think that he can move a great Weight with a little Power, in a little Space; but in all these Mechanical Attempts, that Advantage which is gotten in the Strength of the Motion, must be still allowed for the Slowness of it.

Tho' these Contrivances do so extreamly increase the Power, yet they do proportionably protract the Time. That which by such Helps one man may do in a hundred Days, may be done by the immediate Strength of a hundred Men in one Day.

CHAP. XVI.

That it is possible to contrive such an Artificial Motion, as shall be of a Slowness proportionable to the Swiftness of the Heavens.

IT were a pretty Subtilty to enquire after, Whether or no it be not possible to contrive such an Artificial Motion, that should be in such a Proportion slow, as the Heavens are supposed to be swift.

For the exact Resolution of which, it would be requisite that we should first pitch upon some *Medium*, or indifferent Motion, by the Distance from which, we may judge of the Proportions on either side, whether Slowness, or Swiftness. Now, because there is not any such *Natural Medium*, which may

may be absolutely stiled an indifferent Motion, but that the Swiftness and Slowness of every thing is still proportioned either to the Quantity of Bodies in which they are, or some other particular End for which they are designed; therefore we must take Liberty to suppose such a Motion; and this we may conceive to be about 1000 Paces, or a Mile in an Hour.

The Starry Heaven, or 8th Sphere is thought to move 42398437 Miles in the same Space: So that if it may be demonstrated that it is possible to contrive such a Motion, which going on in a constant direct Course, shall pass but the 42398437 Part of a Mile in an Hour; it will then be evident, that an artificial Motion may be slow, in the same Proportion as the Heavens are swift.

Now it was before manifested, that according to the Difference betwixt the Weight and Power, so will the Difference be betwixt the Slowness or Swiftness of their Motions; whence it will follow, that in such an Engine, wherein the Weight shall be 42398437 Pounds, and the Power that doth equiponderate it, but the 42398437 Part of a Pound (which is easie to contrive) in this Engine the Power being supposed to move with such a Swiftness as may be answerable to a Mile an Hour, the Weight will pass but the 42398437 Part of a Mile in the same Space, and so consequently will be proportionably slow unto the Swiftness of the Heavens.

It is related by our Country-man *I. Dee*, that he and *Cardan* being both together in their Travels, did see an Instrument which was at first sold for 20 Talents of Gold, wherein there was one Wheel, which constantly moving round amongst the rest, did not finish one Revolution under the Space of Seven thousand Years. Preface to *Euclid.*

But if we farther consider such an Instrument of Wheels as was mentioned before in the 14th Chapter,

with

with which the whole World might be eaſily moved, we ſhall then find that the Motion of the Weight by that, muſt be much more ſlow, than the Heavens are ſwift. For tho' we ſuppoſe (ſaith *Stevinus*) the Handle of ſuch anEngine with 12 Wheels to be turned about 4000 Times in an Hour, (which is as often as a Man's Pulſe doth beat) yet in 10 YearsSpace the Weight by this would not be moved above $\frac{1051 2}{2400}$ ooooooooooooooooo Parts of one Foot, which is nothing near ſo much as a Hairs breadth. And it could not paſs an Inch in 1000000 Years, ſaith *Merſennus*.

De ſtat. pract.

Phænom. Mechan. Prop. 11.

The Truth of which we may more eaſily conceive, if we conſider the Frame and Manner of this 12 wheel'd Engine. Suppoſe that in each Axis or Nut, there were ten Teeth, and on each Wheel a thouſand: Then the Sails of this Engine muſt be turned a hundred Times, before the firſt Wheel, (reckoning downward) could be moved round once, and Ten thouſand Times before the ſecond Wheel can finiſh one Revolution, and ſo through the 12 Wheels, according to this multiplied Proportion.

So that beſides the Wonder which there is in the Force of theſe Mechanical Motions, the extream Slowneſs of them is no leſs admirable. If a Man conſiders that a Body ſhould remain in ſuch a conſtant direct Motion, that there could not be one Minute of Time, wherein it did not rid ſome Space and paſs on further, and yet that this Body in many Years together ſhould not move ſo far as a Hair's Breadth.

Which notwithſtanding may evidently appear from the former Inſtance. For ſince it is a natural Principle, that there can be no Penetration of Bodies; and ſince it is ſuppoſed, that each of the Parts in this Engine do touch one another in their Superficies; therefore it muſt neceſſarily follow, that the

Weight

Weight does begin and continue to move with the Power; and (however it is insensible) yet it is certain there must be such a Motion so extreamly slow as is here specified. So full is this Art of rare and incredible Subtilties.

I know it is the Assertion of *Cardan*, *Motus valde tardi, necessario quietes habent intermedias.* Extream slow Motions have necessarily some intermediate Stops and Rests. But this is only said, not proved, and he speaks it from sensible Experiments, which in this case are fallible: Our Senses being very incompetent Judges of the several Proportions, whether Greatness or Littleness, Slowness or Swiftness, which there may be amongst things in Nature. For ought we know, there may be some *Organical* Bodies as much less than ours, as the Earth is bigger. We see what strange Discoveries of extream minute Bodies, (as Lice, Wheal-worms, Mites, and the like) are made by the *Microscope*, wherein their several Parts (which are altogether invisible to the bare Eye) will distinctly appear: And perhaps there may be other Insects that live upon them as they do upon us. 'Tis certain that our Senses are extreamly disproportioned for comprehending the whole Compass and Latitude of Things. And because there may be such difference in the *Motion* as well as in the *Magnitude* of Bodies; therefore, tho' such extream Slowness may seem altogether impossible to Sense and common Apprehension, yet this can be no sufficient Argument against the Reality of it.

De varietate rerum l. 9. c. 47.

CHAP.

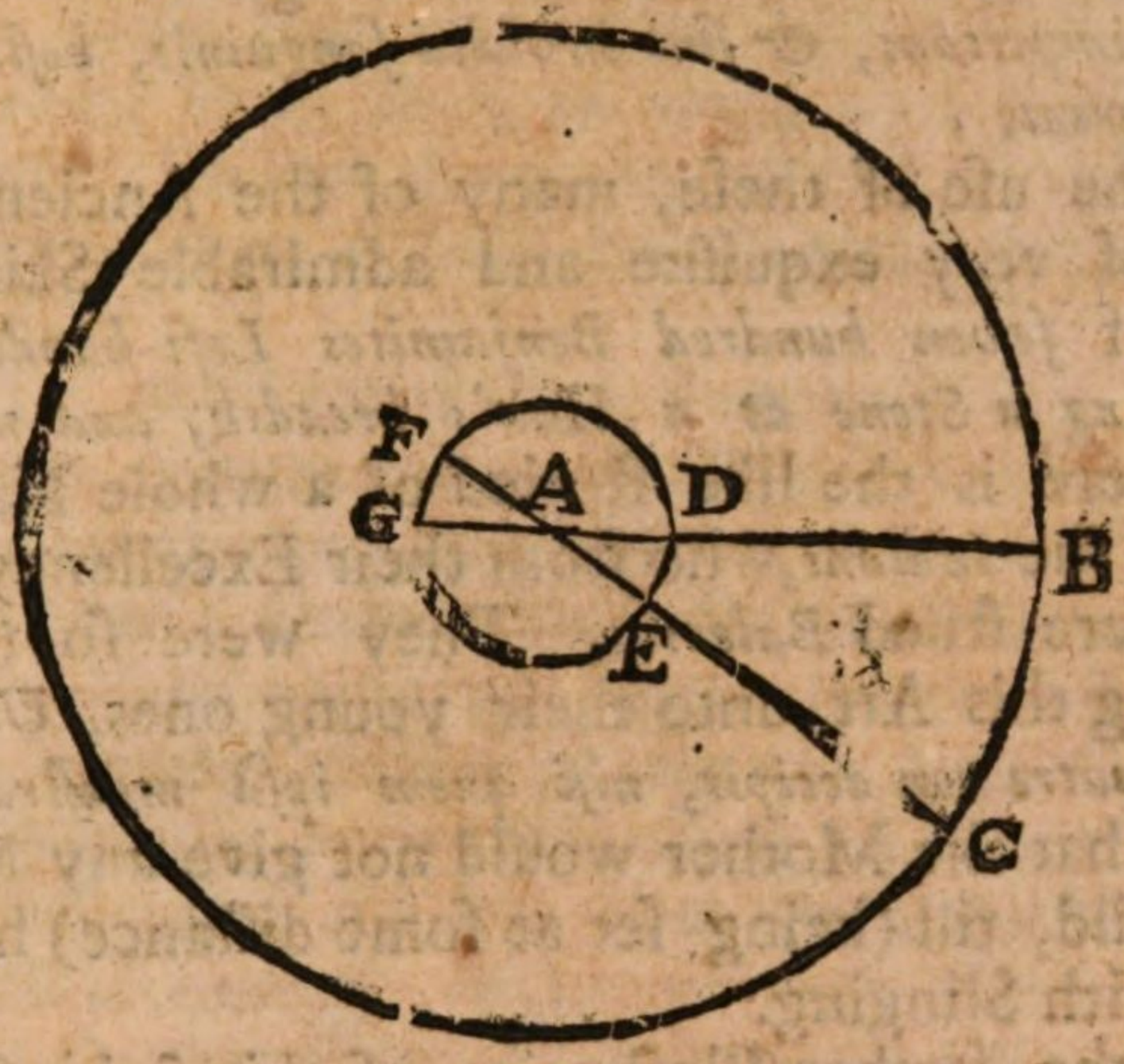
CHAP. XVII.

Of Swiftneſs: How it may be increaſed to any kind of Proportion. Concerning the great Force of Archimedes *his Engines. Of the* Balliſta.

BY that which hath been already explained concerning the Slowneſs of Motion, we may the better underſtand the Nature of Swiftneſs, both of them (as is the Nature of Oppoſites) being produced by contrary Cauſes. As the greatneſs of the Weight in reſpect of the Power, and the great diſtance of the Power from the Fulciment in compariſon to that of the Weight, does cauſe a ſlow Motion; ſo the greatneſs of the Power above the Weight, and the greater diſtance of the Weight from the Center, in compariſon to that of the Power, does cauſe a ſwift Motion.

And as it is poſſible to contrive a Motion unto any kind of Slowneſs, by finding out an anſwerable Diſproportion betwixt the Weight and Power, ſo likewiſe unto any kind of Swiftneſs: For ſo much as the Weight does exceed the Power, by ſo much will the Motion of the Weight be ſlower, and ſo much as the Power does exceed the Weight, by ſo much will the Motion of the Weight be ſwifter.

In



In the Diagram ſet down before, if we ſuppoſe *F* to be the place of the Power, and *C* of the Weight, the Point *A* being the Fulciment or Center, then in the ſame ſpace of time wherein the Power does move from *F* to *G*, the Weight will paſs from *C* to *B*. Theſe Diſtances having the ſame diſproportion unto one another, as there is betwixt *AF* and *AC*, which is ſuppoſed to be Quadruple. So that in this Example, the Weight will move four times ſwifter than the Power; and according as the Power does exceed the Weight in any greater diſproportion, ſo will the ſwiftneſs of the Weight be augmented.

Hence may we conceive the Reaſon of that great Force which there is in Slings, which have ſo much a greater ſwiftneſs than a Stone thrown from the Hand, by how much the end of the Sling is farther off from the Shoulder-Joint, which is the Center of Motion. The Sacred Hiſtory concerning *David's* Victory over *Goliah*, may ſufficiently evidence the force of theſe. *Vegetius* relates that it was uſual this way to ſtrike a Man dead, and beat the Soul out of

1 Sam. 17. 49.

Lipſius Polior. l. 4. Dialog. 2.

his Body, without ſo much as breaking his Armour, or fetching Blood. *Membris integris læthale tamen vulnus important, & ſine invidia ſanguinis, hoſtis lapidis ictu intereat.*

In the uſe of theſe, many of the Ancients have been of very exquiſite and admirable Skill. We read of *ſeven hundred Benjamites Left-handed, that could ſling a Stone at a Hair's breadth, and not miſs.* And there is the like ſtoried of a whole Nation amongſt the *Indians*, who from their Excellency in this Art, were ſtiled *Baleares*. They were ſo ſtrict in teaching this Art unto their young ones, *Ut cibum puer à matre non accipit, niſi quem ipſâ monſtrante percuſſit*; that the Mother would not give any Meat to her Child, till (being ſet at ſome diſtance) he could hit it with Slinging.

Judges 20. 16.

ἀπὸ τῦ βάλλειν, *Diodor. Sicul. Biblioth. l. 5. L. Florus Hiſt. l. 3. cap. 8. Io. Boemus Aubanus de moribus gentium, l. 3. c. 26.*

For the farther Illuſtration of this Subject, concerning the *Swiftneſs* of Motion, I ſhall briefly ſpecify ſome Particulars concerning the Engines of War uſed by the Ancients. Amongſt theſe, the moſt famous and admirable were thoſe invented by *Archimedes*; by which he did perform ſuch ſtrange Exploits, as (were they not related by ſo many and ſuch judicious Authors) would ſcarce ſeem credible even to theſe more Learned Ages. The Acts of that moſt famous Engineer, are largely ſet down by [a] *Polybius*, [b] *Tzetzes*, [c] *Proclus*, [d] *Plutarch*, [e] *Livy*, and divers others. From the firſt of whom alone, we may have ſufficient Evidence for the Truth of thoſe Relations: For beſides that he is an Author noted to be very grave and ſerious in his Diſcourſe, and does ſolemnly promiſe in one Place that he will relate nothing, but what either he himſelf was an Eye-witneſs of, or elſe what he had received from thoſe that were ſo: I ſay, beſides all this, it is conſiderable, that he himſelf was Born not above Thirty Years after the Siege of *Syracuſe*. And afterwards having occaſion to tarry ſome Weeks in that City, when

[a] *Hiſtor. l. 4.*
[b] *Hiſtor. Chilios 2. Hiſtor. 35.*
[c] *Li. 2. c. 3.*
[d] *Marcellus.*
[e] *Hiſtor. l. 24.*

Hiſtor. l. 4. juxta initium.

when he travelled with *Scipio*, he might there perhaps ſee thoſe Engines himſelf, or at leaſt take his Information from ſuch as were Eye-witneſſes of their force: So that there can be no colourable Pretence for any to diſtruſt the Particulars related of them.

In brief, the Sum of their Reports is this. When the *Roman* Forces under the Conduct of *Marcellus*, had laid Siege unto that famous City, (of which, both by their former Succeſſes, and their preſent Strength, they could not chuſe but promiſe themſelves a ſpeedy Victory;) yet the Arts of this one Mathematician, notwithſtanding all their Policies and Reſolutions, did ſtill beat them back to their great Diſadvantage. Whether they were near the Wall, or farther from it, they were ſtill expoſed to the force of his Engines, ϰ μακρὸν ἀφεςῶτας, ϰ συνέσγυς ὄντας, ἃ μόνον ἀπροϊκτους παρεσκεύαζε τοῖς τὰς ἰδίας βολὰς, ἀλλὰ ϰ διέφθειρε τὰς πλείςας αὐτῶν. From the Multitude of thoſe Stones and Arrows which he ſhot againſt them, was he ſtiled ἑκατόγχειρ or *Briareus*. Thoſe Defenſive Engines that were made by the *Romans* in the form of Pent-Houſes, for to cover the Aſſailants from the Weapons of the Beſieged, theſe would he preſently batter in pieces with great Stones and Blocks. Thoſe high Towers erected in ſome of the Ships, out of which the *Romans* might more conveniently fight with the Defendants on the Wall, theſe alſo were ſo broken by his Engines, that no Cannon, or other Inſtrument of Gunpowder, (ſaith a Learned Man) had they been then in uſe, could have done greater Miſchief. In brief, he did ſo moleſt them with his frequent and prodigious Batteries, that the Common Soldiers were utterly diſcouraged from any hopes of Succeſs.

Cæl. Rhod. Ant. lect. l. 2. c. 16. *Pluteus* *Teſtudo.*

Sir *Walt. Raleigh Hiſtor. l. 5. c. 3. §. 16.*

What was the particular Frame and Manner of theſe Engines, cannot certainly be determined; but to contrive ſuch as may perform the like ſtrange

Effects, were not very difficult to any one who is thoroughly verſed in the Grounds of this Art. Tho' perhaps thoſe of *Archimides* in reſpect of divers Circumſtances, were much more exact and proper for the Purpoſes to which they were intended, than the Invention of others could be; he himſelf being ſo extraordinarily ſubtle and ingenious above the common ſort of Men.

'Tis probable that the general kind of theſe Engines were the ſame with thoſe that were uſed afterwards, amongſt the *Romans* and other Nations. Theſe were commonly divided into two ſorts; ſtiled

{ *Balliſtæ.*
{ *Catapultæ.*

Vid. Naudæum de Stud. Militar. l. 2.

Both which Names are ſometimes uſed promiſcuouſly; but according to their Propriety, † *Balliſta* does ſignifie an Engine for the ſhooting of Stones, and *Catapulta* for Darts or Arrows.

† ἀπὸ τῆς βάλλειν, called alſo λιθοβόλος. πετροβόλος. *Fundibalus. Petraria.*

The former of theſe was fitted either to carry divers leſſer Stones, or elſe one greateſt one. Some of theſe Engines made for great Stones, have been proportioned to ſo vaſt and immenſe a Weight, as may ſeem almoſt incredible; which occaſioned that in *Lucan*, *Lib.* 3.

At ſaxum quoties ingenti verberis ictu
Excutitur, qualis rupes quam vertice montis
Abſcidit impulſu ventorum adjuta vetuſtas,
Frangit cuncta rumes; nec tantum corpora preſſa
Exanimat, totos cum ſanguine diſſipat artus.

With theſe they could eaſily batter down the Walls and Towers of any Fort. So *Ovid.*

Quam grave balliſtæ mœnia pulſat onus.

And *Statius*---*Quo turbine bellica quondam.*

Librati ſaliunt portarum in clauſtra molares.

Lipſius Poliorcet. l. 3. Dial. 3.

The Stones that were caſt from theſe, were of any form, *Enormes & ſepulchrales*, Mill-ſtones or Tomb-ſtones. Sometimes for the farther annoyance

and

and terror of any Beſieged Place, they would by theſe throw into it dead Bodies, either of Men or Horſes, and ſometimes only parts of them as Men's Heads.

Athenæus mentions one of theſe *Balliſtæ* that was proportioned unto a Stone of three Talents Weight, each Talent being 120 Pounds (ſaith *Vitruvius*), ſo that the whole will amount to 360 Pounds. But it is ſtoried of *Archimedes*, that he caſt a Stone into one of *Marcellus* his Ships, which was found to weigh ten Talents. There is ſome difference amongſt * Authors, concerning what kind of Talent this ſhould be underſtood, but it is certain that in *Plutarch*'s Time, (from whom we have this Relation) one Talent did amount to 120 Pounds (ſaith *Suidas:*) According to which Account, the Stone it ſelf was of no leſs then twelve hundred pound Weight. A Weapon (one would think) big enough for thoſe Rebel Gyants that fought againſt the Gods. Now the greateſt Cannon in uſe, does not carry above 64 pound Weight, which is far ſhort of the ſtrength in theſe Mathematical Contrivances. Amongſt the *Turks* indeed, there have been ſometimes uſed ſuch Powder Inſtruments, as may equal the force of thoſe invented by *Archimedes*. *Gab. Naudæus* tells us of one Bullet ſhot from them at the Siege of *Conſtantinople*, which was of above 1200 pound Weight; This he affirms from the Relation of an Archbiſhop, who was then preſent, and did ſee it; the Piece could not be drawn by leſs then a hundred and fifty Yoak of Oxen, which might almoſt have ſerved to draw away the Town it ſelf. But though there hath been perhaps ſome one or two Cannons of ſuch a prodigious Magnitude, yet it is certain that the biggeſt in common Uſe, does come far ſhort of that Strength which was ordinarily in theſe Mechanical Engines.

Deipnoſoph. l. 5.

Archit. l. 10. c. ult. λίθον δεκατάλαντον.

Plut. Marcell.

* *Dav. Rivaltus Comm. in Archim. Oper. Ext.*

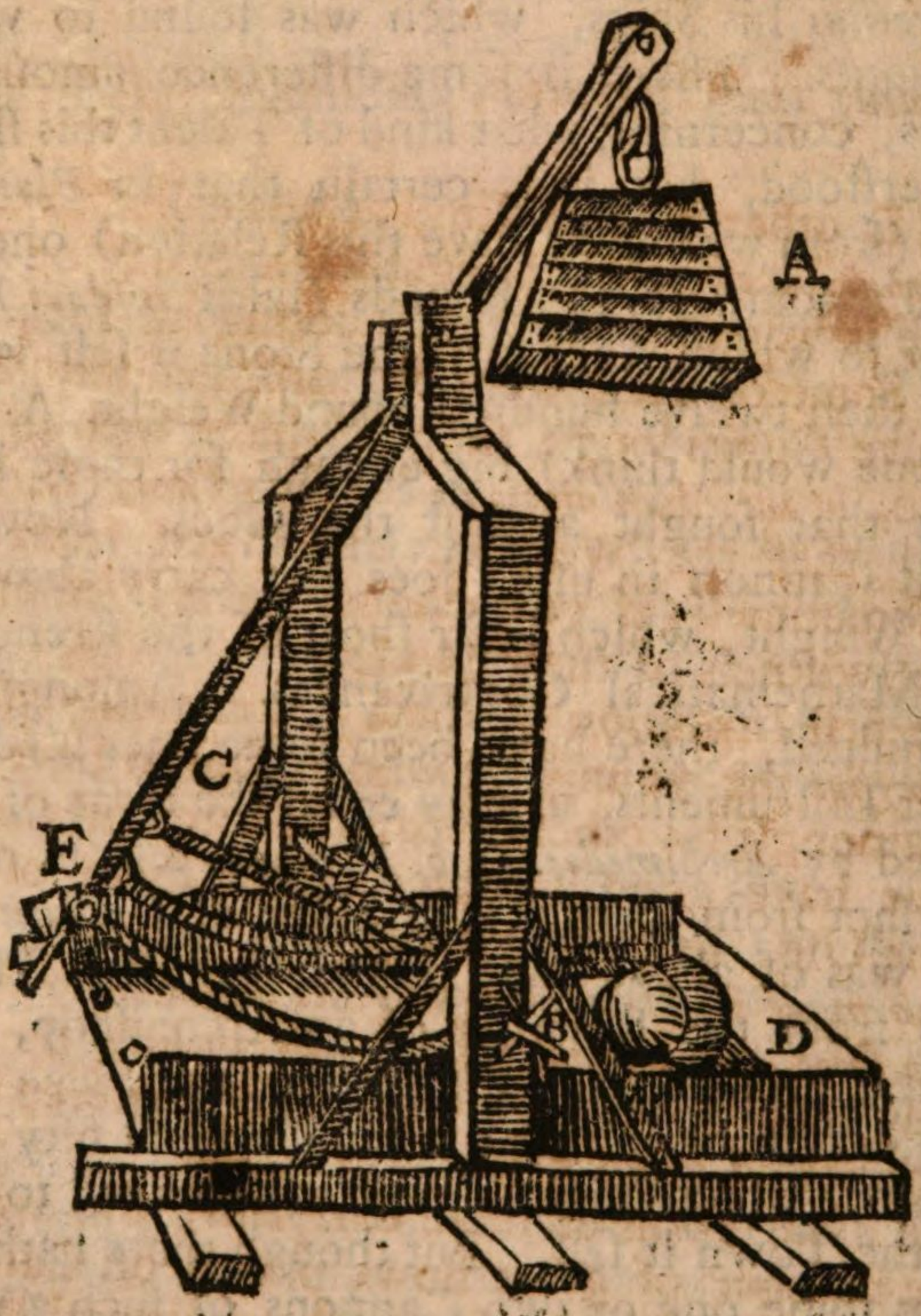
Naudæus de ſtudio. Milit. l. 2.

De Stud. Mil. l. 2.

See *Rob. Valteurius de re Milit. l. 10. c. 4.*

There are divers Figures of theſe *Balliſtæ*, ſet out by *Vegetius*, *Lipſius*, and others; but being without any Explication, it is not very facil to diſcover in what their Forces did conſiſt.

I have here expreſſed one of them moſt eaſy to be apprehended; from the Underſtanding of which, you may the better gueſs at the Nature of the reſt.



That great Box or Cavity at *A*, is ſuppoſed to be full of ſome heavy Weight, and is forced up by the turning of the Axis and Spokes *B C*. The Stone or Bullet to be diſcharged, being in a kind of Sling

at

at *D*; which when the greater Weight *A* deſcends, will be violently whirled upwards, till that end of the Sling at *E*, coming to the Top will fly off, and diſcharge the Stone as the skilful Artiſt ſhould direct it.

CHAP. XVIII.

Concerning the Catapultæ, or Engines for Arrows.

THE other kind of Engine was called *Catapulta*, ἀπὸ τ πέλτης, which ſignifies a Spear or Dart, becauſe it was uſed for the Shooting off ſuch Weapons: Some of theſe were proportioned unto Spears of twelve Cubits long; they did carry with ſo great a Force, *ut interdum nimio ardore ſcintillant*, (ſaith *Ammianus*) that the Weapons diſcharged from them were ſometimes (if you can believe it) ſet on Fire by the ſwiftneſs of their Motion.

In Greek καταπέλτης. *Athenæus. Deipnoſ. l.* 5. *Lib.* 23. *Lipſius Poliorcet. l.* 3. *Dial.* 2.

The firſt Invention of theſe is commonly aſcribed to *Dionyſius* the younger, who is ſaid to have made them amongſt his other Preparations againſt *Carthage*. But we have good Reaſon to think them of more ancient Uſe, becauſe we read in Scripture, That *Uzziah made in Jeruſalem Engines invented by cunning Men to ſhoot Arrows and great Stones withal*; though it is likely theſe Inventions were much bettered by the Experience of after Ages.

Diod. Sicul. Biblioth. l. 14. *Sardus de Invent. Rerum. l.* 2. 2 Chron. 26. 15.

The uſual Form of theſe *Catapultæ*, was much after the manner of great Bows placed on Carriages, and wound up by the Strength of ſeveral Perſons. And from that great Force which we find in leſſer Bows, we may eaſily gueſs at the greater Power of theſe other Engines. 'Tis related of the *Turkiſh* Bow, that it can ſtrike an Arrow through a piece of Steel

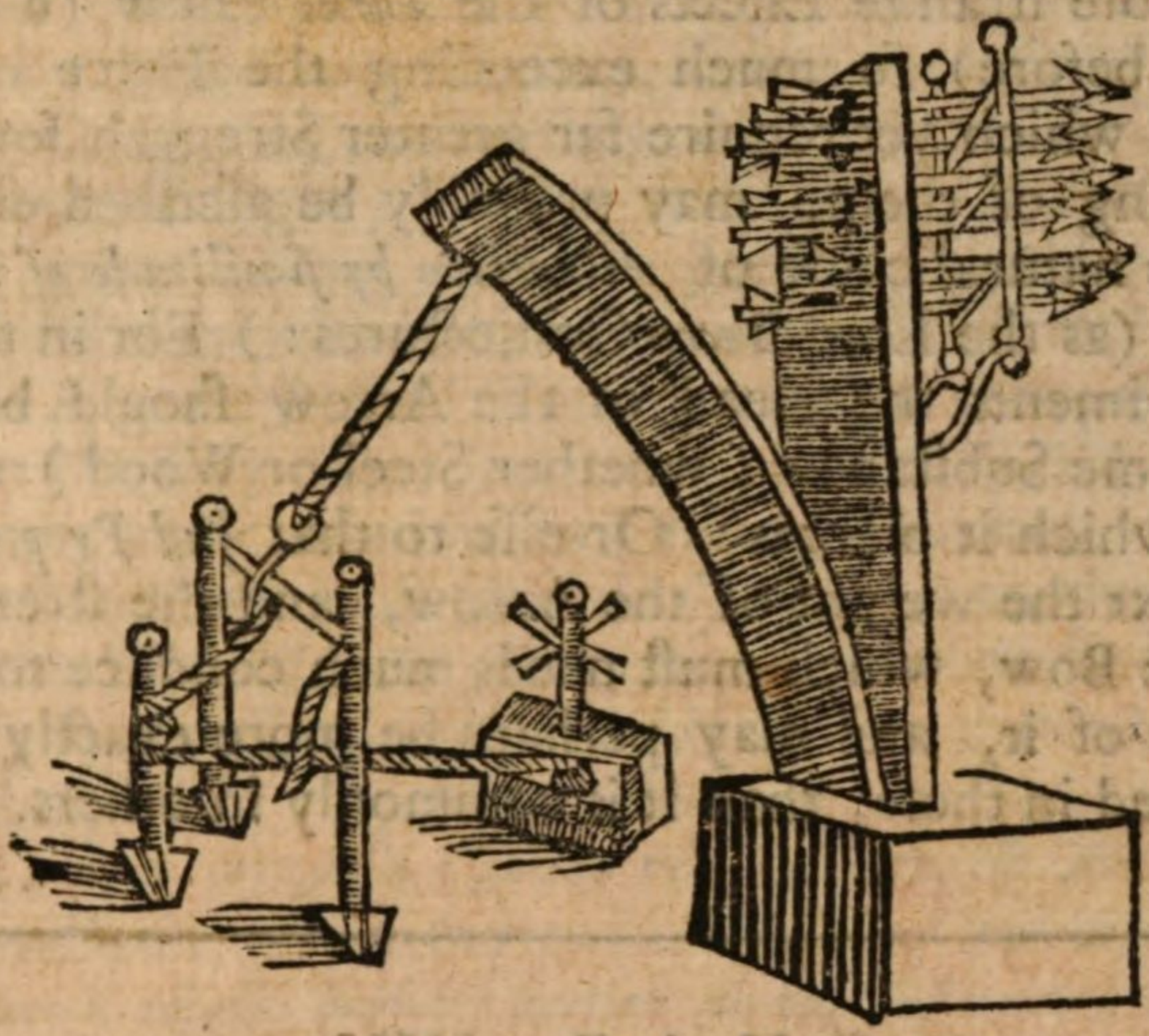
Sir Fran. Bacon. *Nat. Hiſt. Exp.* 704.

or Braſs two Inches thick, and being headed only with Wood, it pierces Timber of eight Inches. Which though it may ſeem incredible, yet it is atteſted by the Experience of divers unqueſtionable Witneſſes: *Barclay* in his *Icon animorum*, a Man of ſufficient Credit, affirms that he was an Eye-witneſs, how one of theſe Bows with a little Arrow did pierce through a piece of Steel three Fingers thick. And yet theſe Bows being ſomewhat like the long Bows in uſe amongſt us, were bent only by a Man's immediate Strength, without the help of any Bender or Rack that are uſed to others.

Some *Turkiſh* Bows are of that Strength, as to pierce a Plank of ſix Inches in thickneſs, (I ſpeak what I have ſeen) ſaith *M. Jo. Greaves* in his *Pyramodographia*. How much greater Force then may we conceive to be impreſſed by the *Catapultæ*?

Theſe were ſometimes framed for the diſcharging of two or three Arrows together, ſo that each of them might be directed unto a ſeveral Aim. But it were as eaſy to contrive them after the like manner for the Carriage of twenty Arrows, or more; as in this Figure.

Both



Both theſe kinds of Engines, when they were uſed at the Siege of any City, were commonly carried in a great wooden Turret (firſt invented by * *Demetrius.*) It was driven upon four Wheels at the bottom, each of its Sides being forty five Cubits, its Height ninety. The whole was divided in nine ſeveral Partitions, every one of which did contain divers Engines for Battery: From its Uſe in the battering and taking of Cities it is ſtiled by the Name of *Helepolis.*

He that would be informed in the nature of Bows, let him conſult *Merſennus de Balliſtica & Acontiſmologia,* where there are divers ſubtile Enquiries and Demonſtrations, concerning the Strength required to the bending of them to any Diſtance. The Force they have in the Diſcharge, according to ſeveral Bents, the Strength required to be in the String of them, the ſeveral Proportions of Swiftneſs and Diſtance in an Arrow ſhot Vertically, or Horizontally, or Tranſverſally.

* Who was therefore ſtiled *Poliorcetes.* This kind of Turret was firſt uſed at the Siege of *Cyprus,* & is thus deſcribed by *Diodorus Sicul. Biblioth. l.* 20.

Thoſe

Thoſe ſtrange Effects of the *Turkiſh* Bow (mentioned before) ſo much exceeding the Force of others, which yet require far greater Strength for the Bending of them, may probably be aſcribed either to the natural cauſe of *Attraction by ſimilitude of Subſtance* (as the Lord *Bacon* Conjectures:) For in theſe Experiments the Head of the Arrow ſhould be of the ſame Subſtance (whether Steel or Wood) with that which it pierces: Or elſe to that *juſt Proportion* betwixt the weight of the Arrow, and the ſtrength of the Bow, which muſt needs much conduce to the Force of it, and may perhaps be more exactly diſcovered in theſe, than it is commonly in others.

CHAP. XIX.

A Compariſon betwixt theſe ancient Engines, and the Gunpowder Inſtruments now in Uſe.

IT ſhall not be altogether Impertinent to enquire ſomewhat concerning the Advantages and Diſadvantages betwixt thoſe Military offenſive Engines uſed amongſt the Ancients, and thoſe of theſe later Ages.

In which Enquiry there are two Particulars to be chiefly examined.

1. The Force of theſe ſeveral Contrivances, or the utmoſt that may be done by them.

2. Their Price, or the greatneſs of the Charges required unto them.

1. As for the Force of theſe ancient Inventions, it may ſufficiently appear from thoſe many credible Relations mentioned before; to which may be added that in *Joſephus*, which he ſets down from his own Eye-ſight, being himſelf a chief Captain at the Siege of *Jotapata*, where theſe Events happened. He tells

De bello Judaico. l. 3. c. 9.

us

us that beſides the multitude of Perſons, who were ſlain by theſe *Roman* Engines, being not able to avoid their Force, by reaſon they were placed ſo far off, and out of Sight; beſides this, they did alſo carry ſuch great Stones, with ſo great a Violence, that they did therewith batter down their Walls and Towers. A great Bellied Woman walking about the City in the Day-time, had her Child ſtruck out of her Womb, and carried half a Furlong from her. A Soldier ſtanding by his Captain *Joſephus*, on the Wall, had his Head ſtruck off by another Stone ſent from theſe *Roman* Engines, and his Brains carried three Furlongs off.

To this purpoſe *Cardan* relates out of *Ammianus Marcellinus*. *Tanto impetu fertur lapis ut uno viſo lapide quamvis intacti barbari fuerint ab eo, deſtiterunt à pugnâ & abierunt.* Many foreign People being ſo amazed at the ſtrange force of theſe Engines, that they durſt not conteſt with thoſe who were Maſters of ſuch Inventions. 'Tis frequently aſſerted, that Bullets have been melted in the Air, by that Extremity of violent Motion impreſt from theſe Slings. *De variet. l. 12. c. 58.*

Fundáque contorto tranſverberat aëra plumbo,
Et mediis liquidæ glandes in nubibus errant.

So *Lucan*, ſpeaking of the ſame Engines.

Inde faces & ſaxa volant, ſpatioque ſolutæ
Aeris & calidæ liquefactæ pondere glandes.

Which Relations, though they may ſeem ſomewhat Poetical and Improbable, yet *Ariſtotle* himſelf (*De cœlo lib.* 2. *c.* 7.) doth ſuppoſe them as unqueſtionable. From whence it may be inferred, that the force of theſe Engines does rather exceed than come ſhort of our Gunpowder Inventions. *Sir* Walt. Raleigh. *Hiſt. l.* 5. *c.* 3. *Sect.* 16.

Add to this that Opinion of a Learned Man (which I cited before) that *Archimedes* in the Siege of *Syracuſe* did more miſchief with his Engines, than could have been wrought by any Cannons, had they been then in Uſe. See *Lipſius de militiâ Romanâ. l.* 5.

In

In this perhaps there may be ſome Diſadvantage, becauſe theſe Mathematical Engines cannot be ſo eaſily and ſpeedily wound up, and ſo certainly levelled as the other may.

2. As for the Price or Charges of both theſe, it may be conſidered under three Particulars:

1. Their making.
2. Their Carriage or Conveyance.
3. Their Charge and Diſcharging.

In all which reſpects, the Cannons now in Uſe, are of much greater Coſt than theſe other Inventions.

1. The Making or Price of theſe Gun-powder Inſtruments is extreamly Expenſive, as may be eaſily judged by the weight of their Materials. A whole Cannon weighing commonly 8000 *l.* a half Cannon 5000, a Culverin 4500, a Demiculverin 3000; which whether it be in Iron or Braſs, muſt needs be very Coſtly, only for the Matter of them; beſides the farther Charges required for the Form and Making of them, which in the whole muſt needs amount to ſeveral hundred Pounds. Whereas theſe Mathematical Inventions conſiſting chiefly of Timber, and Cords, may be much more cheaply made; The ſeveral degrees of them which ſhall anſwer in proportion to the Strength of thoſe other, being at the leaſt ten times Cheaper; that is, ten Engines that ſhall be of equal force either to a Cannon or Demicannon, Culverin or Demiculverin, may be framed at the ſame Price that one of theſe will amount to: So that in this reſpect there is a great Inequality.

2. As for their Carriage or Conveyance; a whole Cannon does require at the leaſt 90 Men, or 16 Horſes, for the Draught of it; a half Cannon 56 Men, or 9 Horſes; a Culverin 50 Men, or 8 Horſes; a Demiculverin 36 Men, or 7 Horſes; Suppoſing the Way to be hard and plain, in which notwithſtanding the Motion will be very ſlow. But if the

Paſſage

Paſſgae prove riſing and ſteep, or rotten and dirty, then they will require a much greater Strength and Charge for the conveyance of them. Whereas theſe other Inventions are in themſelves more light (if there be occaſion for the Draught of them) being eaſily taken aſunder into ſeveral Parts. And beſides, their Materials are to be found every where, ſo that they need not be carried up and down at all, but may be eaſily made in the Place where they are to be uſed.

3. The Materials required to the Charging of theſe Gun-powder Inſtruments, are very Coſtly. A whole Cannon requiring for every Charge 40 Pound of Powder, and a Bullet of 64 Pounds; a half Cannon 18 Pound of Powder, and a Bullet of 24 Pounds; a Culverin 16 Pounds of Powder, and a Bullet of 19 Pounds; a Demiculverin 9 Pounds of Powder, and a Bullet of 12 Pounds: Whereas thoſe other Engines may be charged only with Stones, or (which may ſerve for Terror) with dead Bodies, or any ſuch Materials as every Place will afford without any Coſt.

So then, put all theſe together: If it be ſo that thoſe ancient Inventions did not come ſhort of theſe other in regard of Force, and if they do ſo much excel them in divers other Reſpects; it ſhould ſeem then, that they are much more Commodious then theſe latter Inventions, and ſhould be preferred before them. But this Enquiry cannot be fully determined without particulat Experience of both.

CHAP.

CHAP. XX.

That it is possible to contrive such an Artificial Motion, as may be equally swift with the supposed Motion of the Heavens.

FOR the Conclusion of this Discourse, I shall briefly Examine (as before concerning Slowness) whether it be possible to contrive such an Artificial Motion, as may be equal unto the supposed swiftness of the Heavens. This Question hath been formerly propoſed and answered by *Cardan*, where he applies it unto the swiftness of the Moon's Orb; but that Orb being the lowest of all, and consequently of a dull and sluggish Motion, in comparison to the rest; therefore it will perhaps be more convenient to understand the Question concerning the eighth Sphere, or starry Heaven.

De Variet. Rerum l. 9. c. 47.

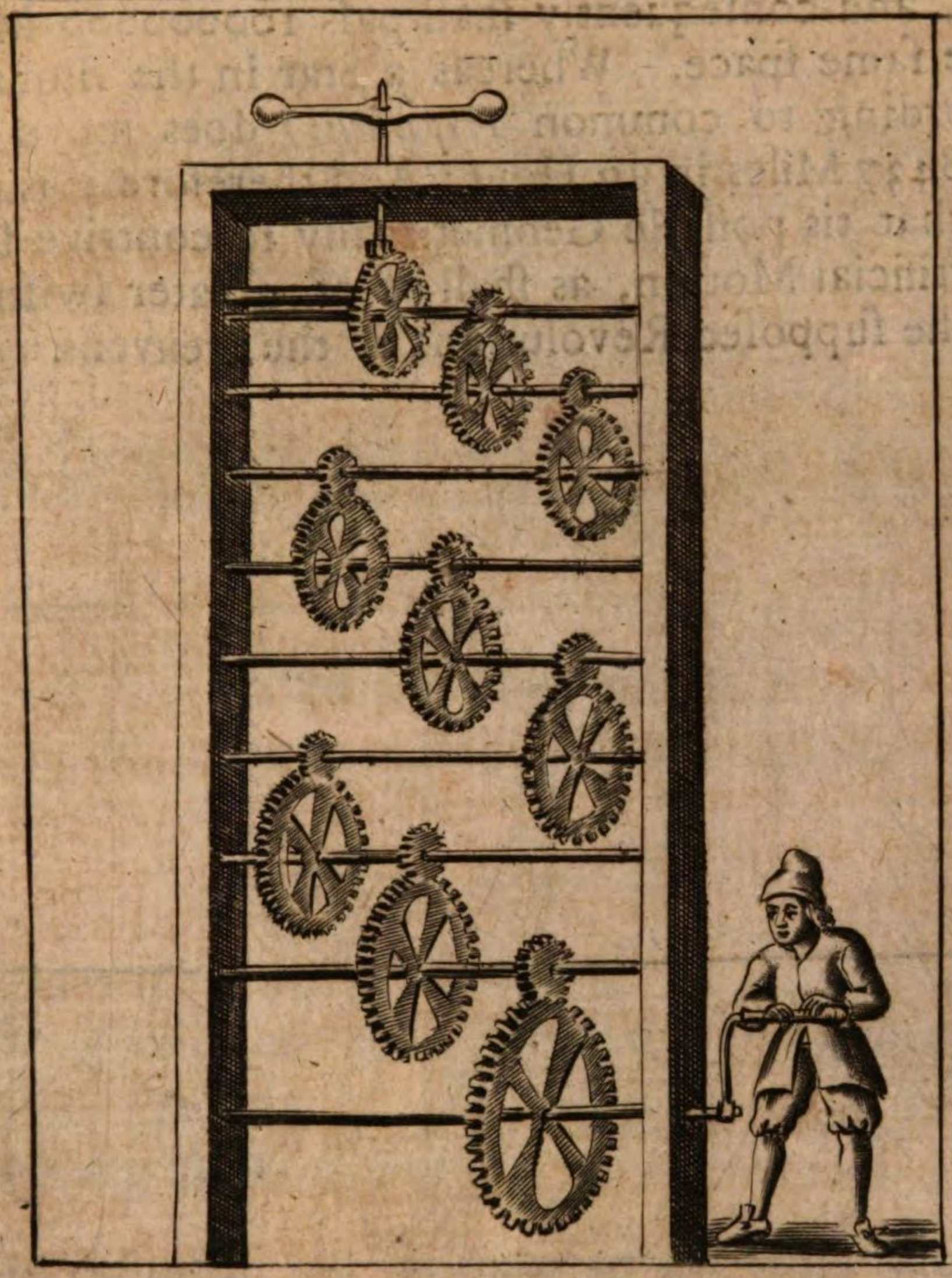
For the true Resolution of this, it should be first observed, that a material Substance is altogether incapable of so great a Celerity, as is usually ascribed to the Celestial Orbs, (as I have proved elsewhere) and therefore the Quære is not to be understood of any real and experimental, but only Notional, and Geometrical Contrivance.

The Earth a Planet, *Prop.* 9.

Now that the swiftness of Motion may be thus increased according to any conceivable Proportion, will be manifest from what hath been formerly delivered concerning the Grounds and Nature of Slowness and Swiftness. For according as we shall suppose the Power to exceed the Weight: So may the Motion of the Weight be swifter than that of the Power.

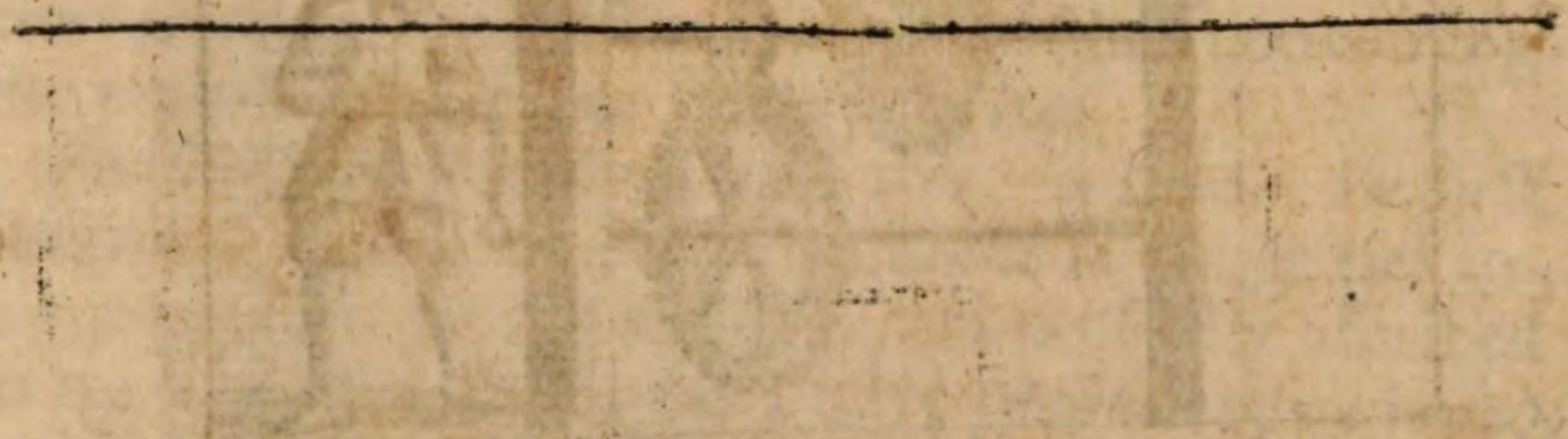
But to answer more particularly: Let us imagine every Wheel in this following Figure to have a hundred Teeth in it, and every Nut ten:

It



It may then be evident, that one Revolution of the firſt Wheel, will turn the Nut, and conſequently the ſecond Wheel on the ſame Axis ten times, the third Wheel a hundred times, the fourth a thouſand times, the fifth 10000, the ſixth a hundred thouſand times, the ſeventh 1000000 times, the eighth 10000000 times, the ninth 100000000 times, the Sails 1000000000 times: So that if we ſuppoſe the compaſs of theſe Sails to be five Foot, or one Pace: And that the firſt Wheel is turned about after the rate of one thouſand times in an Hour: It will then be evident, that the Sails ſhall be turned 1000000000000 times,

times, and consequently shall pass 100000000 Miles in the same space. Whereas a Star in the Æquator (according to common *Hypothesis*) does move but 42398437 Miles in an Hour: And therefore it is evident that 'tis possible Geometrically to contrive such an Artificial Motion, as shall be of greater swiftness then the supposed Revolutions of the Heavens.



DÆDA-

DÆDALUS:

OR,

Mechanical Motions,

The Second Book.

CHAP. I.

The divers kinds of Automata, *or Self-movers. Of Mills, and the Contrivance of ſeveral Motions by rarify'd Air. A brief Digreſſion concerning Wind-Guns.*

AMongſt the Variety of Artificial Motions, thoſe are of moſt Uſe and Pleaſure, in which, by the Application of ſome continued Strength, there is beſtowed a regular and laſting Motion.

Theſe we call the αὐτόματα, or *Self-movers*: Which Name, in its utmoſt Latitude, is ſometimes aſcribed unto thoſe Motions, that are contrived from the Strength of Living Creatures, as Chariots, Carts, *&c.* But in its Strictneſs and Propriety, it is only appliable unto ſuch Inventions, wherein the Motion is cauſed either by ſomething that belongs unto its own Frame, or elſe by ſome External Inanimate Agent.

Whence theſe ἀυτόματα are eaſily diſtinguiſhable into Two ſorts:

1. Thoſe that are moved by ſomething which is extrinſical unto their own Frame; as Mills, by Water or Wind.

2. Thoſe that receive their Motion from ſomething that does belong to the Frame it ſelf; as Clocks, Watches, by Weights, Springs, or the like.

Of both which ſorts, there have been many excellent Inventions: In the Recital of them, I ſhall inſiſt chiefly on ſuch as are moſt eminent for their Rarity and Subtilty.

Amongſt the ἀυτόματα that receive their Motion from ſome external Agent, thoſe of more common uſe are Mills.

And firſt, the Water-Mills; which are thought to be before the other, tho' neither the firſt Author, nor ſo much as the Time wherein they were invented is fully known. And therefore *Polydore Virgil* refers them amongſt other fatherleſs Inventions. *Pliny* indeed doth mention them, as being com- only uſed in his time; and yet others affirm, that *Belliſarius*, in the Reign of *Juſtinian*, did firſt invent them: Whence *Pancirollus* concludes, that it is likely their Uſe was for ſome Space intermitted, and being afterwards renewed again, they were then thought to be firſt diſcovered.

De invent. rerum, l.3. c. 18.

Nat. Hiſt. l.18. c 10.

De Repert. Tit. 22.

However, 'tis certain that this Invention hath much abridged and advantaged the Labours of Men, who were before condemned unto this Slavery, as now unto the Galleys. And as the Force of Waters hath been uſeful for this, ſo likewiſe may it be contrived to divers other Purpoſes. Herein doth the Skill of an Artificer chiefly conſiſt, in the Application of theſe common Motions unto various and beneficial Ends; making them ſerviceable, not only for

Ad Piſtrinum.

for the Grinding of Corn, but for the preparing of Iron, or other Oar; the making of Paper, the elevating of Water, or the like.

To this purpoſe alſo are the Mills that are driven by Wind, which are ſo much more convenient than the other, by how much their Situations may be more eaſie and common. The Motions of theſe may likewiſe be accommodated to as various Uſes as the other; there being ſcarce any Labour, to the Performance of which, an ingenious Artificer cannot apply them. To the Sawing of Timber, the Plowing of Land, or any other the like Service, which cannot be diſpatched the ordinary Way, without much Toil and Tedioufneſs. And it is a wonderful thing to conſider, how much Men's Labours might be eaſed and contracted in ſundry Particulars, if ſuch as were well skilled in the Principles and Practices of theſe Mechanical Experiments, would but thoroughly apply their Studies unto the Enlargement of ſuch Inventions. *Marcell. Vrankbein. Epiſt. ad Joh. Erneſtum.*

There are ſome other Motions by Wind or Air, which (tho' they are not ſo common as the other, yet) may prove of excellent Curioſity, and ſingular Uſe. Such was that Muſical Inſtrument invented by *Cornelius Dreble*; which being ſet in the Sunſhine, would of it ſelf render a ſoft and pleaſant Harmony; but being removed into the Shade, would preſently become ſilent. The Reaſon of it was this: The Warmth of the Sun working upon ſome Moiſture within it, and rarifying the inward Air unto ſo great an Extenſion that it muſt needs ſeek for Vent or Iſſue, did thereby give ſeveral Motions unto the Inſtrument. Like that Statue of *Memnon*, in *Egypt*, which makes a ſtrange noiſe whenever the Sun begins to ſhine upon it. *Tacit. Annal.* 2. *Strabo* affirms, that he had both ſeen and heard it.

Somewhat of this Nature are the *Æolipiles*, which are Concave Veſſels, conſiſting of ſome ſuch Material as may endure the Fire, having a ſmall Hole, at which they are filled with Water, and out of which (when the Veſſels are heated) the Air

doth iſſue forth with a ſtrong and laſting Violence. Theſe are frequently uſed for the exciting and contracting of Heat in the melting of Glaſſes, or Metals: They may alſo be contrived to be ſerviceable for ſundry other pleaſant Uſes; as for the moving of Sails in a Chimney-corner; the Motion of which Sails may be applied to the Turning of a Spit, or the like.

De Variet. Rerum, l. 12. c. 58.

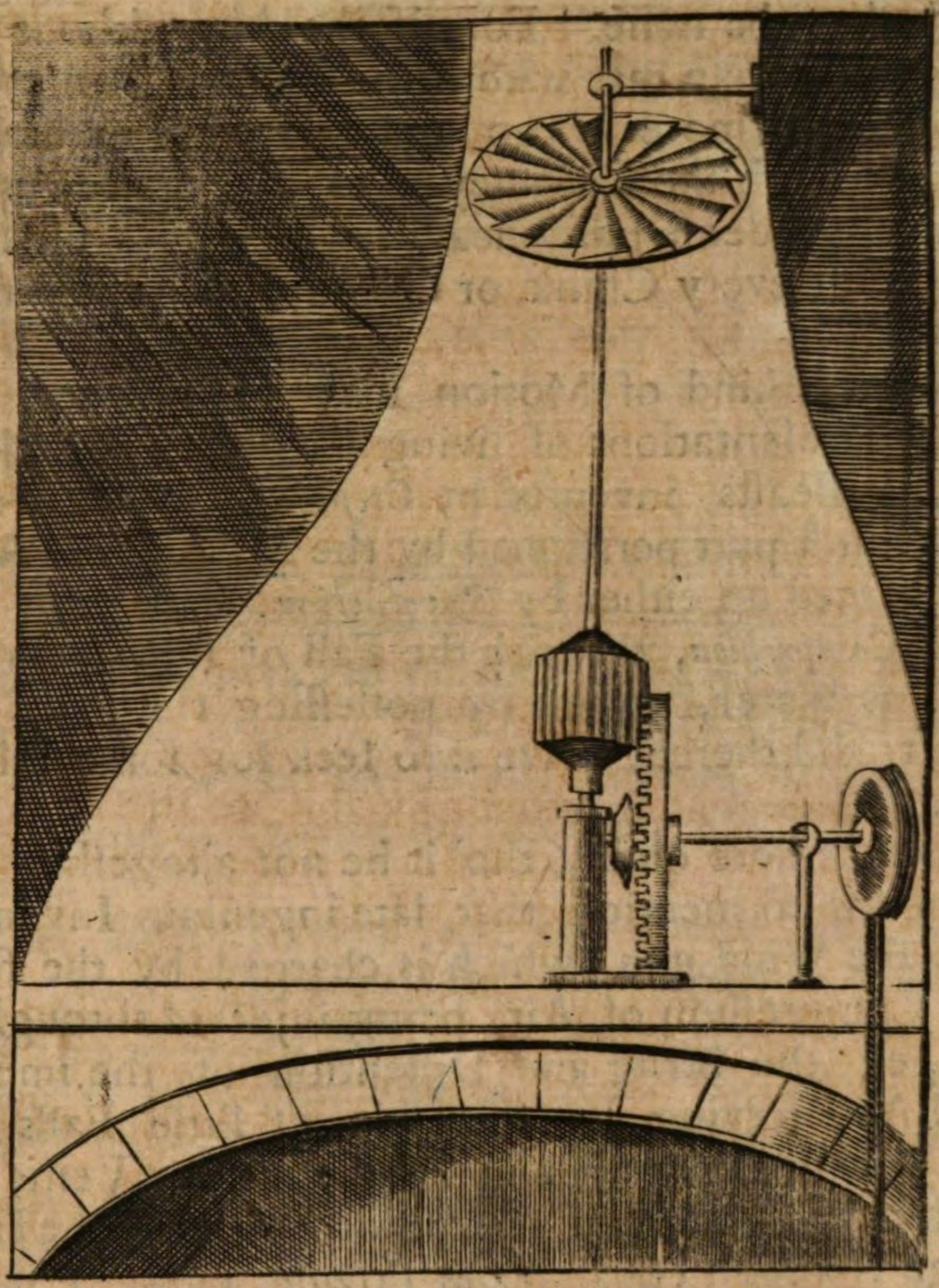
But there is a better Invention to this purpoſe, mentioned in *Cardan*, whereby a Spit may be turned (without the Help of Weights) by the Motion of the Air that aſcends the Chimney; and it may be uſeful for the Roaſting of many, or great Joints: For as the Fire muſt be increaſed according to the Quantity of Meat, ſo the Force of the Inſtrument will be augmented proportionably to the Fire. In which Contrivance, there are theſe Conveniences above the Jacks of ordinary Uſe:

1. It makes little or no Noiſe in the Motion.

2. It needs no winding up, but will conſtantly move of it ſelf, while there is any Fire to rarify the Air.

3. It is much cheaper than the other Inſtruments that are commonly uſed to this purpoſe; there being required unto it only a pair of Sails, which muſt be placed in that part of the Chimney where it begins to be ſtraitned; and one Wheel, to the Axis of which the Spit-line muſt be faſtned, according to this following Diagram.

The



The Motion of theſe Sails may likewiſe be ſerviceable for ſundry other Purpoſes, beſides the turning of a Spit; for the Chiming of Bells, or other muſical Devices; and there cannot be any more pleaſant Contrivance for continual and cheap Muſick. It may be uſeful alſo for the Reeling of Yarn, the Rocking of a Cradle, with divers the like domeſtick Occaſions. For (as was ſaid before) any conſtant Motion being given, it is eaſie for an ingenious Artificer to apply it unto various Services.

Theſe Sails will always move both Day and Night, if there is but any Fire under them, and ſometimes

though there be none. For, if the Air without be much colder than that within the Room, then muſt this which is more warm and rarified, naturally aſcend through the Chimney, to give Place unto the more condenſed and heavy, which does uſually blow in at every Chink or Cranny, as Experience ſhews.

Unto this kind of Motion may be reduced all thoſe Repreſentations of living Creatures, whether Birds, or Beaſts, invented by *Cteſibius*, which were for the moſt part performed by the Motion of Air, being forced up either by *Rarefaction*, with Fire, or elſe by *Compreſſion*, through the Fall of ſome heavier Body, as Water, which by poſſeſſing the Place of the Air, did thereby drive it to ſeek for ſome other Vent.

I cannot here omit (tho' it be not altogether ſo pertinent) to mention that late ingenious Invention of the Wind gun, which is charged by the forcible Compreſſion of Air, being injected through a Syringe; the Strife and Diſtention of the impriſoned Air, ſerving by the Help of little Falls or Shuts within; to ſtop and keep cloſe the Vents by which it was admitted. The Force of it in the Diſcharge is almoſt equal to our Powder-guns. I have found upon frequent Trials (ſaith *Merſennus*) that a leaden Bullet Shot from one of theſe Guns againſt a ſtone Wall, the Space of 24 Paces from it, will be beaten into a thin Plate. It would be a conſiderable Addition to this Experiment, which the ſame Author mentions a little after, whereby he will make the ſame Charge of Air to ſerve for the Diſcharge of ſeveral Arrows or Bullets after one another, by giving the Air only ſo much Room, as may immediately ſerve to impreſs a Violence in ſending away the Arrow or Bullet, and then ſcrewing it down again to its former Confinement, to fit it for another Shooting. But againſt this there may be many con-

Phænomena pneumatica, prop. 32.

ſiderable

siderable Doubts, which I cannot ſtand to diſcuſs.

CHAP. II.

Of a Sailing Chariot, that may without Horſes be driven on the Land by the Wind, as Ships are on the Sea.

THE Force of Wind in the Motion of Sails may be applied alſo to the driving of a Chariot, by which a Man may ſail on the Land, as well as by a Ship on the Water. The Labour of Horſes or other Beaſts, which are uſually applied to this Purpoſe, being artificially ſupplied by the Strength of Winds.

That ſuch Chariots are commonly uſed in the Champion Plains of *China*, is frequently affirmed by divers credible Authors. *Boterus* mentions that they have been tried alſo in *Spain*, tho' with what Succeſs he doth not ſpecifie. But above all other Experiments to this Purpoſe, that ſailing Chariot at *Sceveling* in *Holland*, is more eminently remarkable. It was made by the Direction of *Stephinus*, and is celebrated by many Authors * *Walchius* affirms it to be of ſo great a Swiftneſs for its Motion, and yet of ſo great a Capacity for its Burden: *Ut in medio freto ſecundis ventis commiſſas naves, velocitate multis paraſangis poſt ſe relinquat, & paucarum horarum ſpatio, viginti aut triginta milliaria Germanica continuo curſu emetiatur, concreditoſque ſibi plus minus vectores ſex aut decem, in petitum locum transferat, facillimo illius ad clavum qui ſedet nutu, quaqua verſum minimo labore velis commiſſum, mirabile hoc continenti currus navigium dirigentis.* That it did far exceed the Speed of any Ship, though we ſhould ſuppoſe it to be carried in

De incremento Urbium l. 1. c. 10.

* *Fabularum decas, Fab. 9.*

the open Sea with never ſo proſperous Wind: And that in ſome few Hours Space it would convey Six or Ten Perſons, 20 or 30 *German* Miles, and all this with very little Labour of him that ſitteth at the Stern, who may eaſily guide the Courſe of it as he pleaſeth.

That eminent inquiſitive Man *Peireskius*, having travelled to *Sceveling* for the Sight and Experience of this Chariot, would frequently after with much Wonder mention the extream Swiftneſs of its Motion. *Commemorare ſolebat ſtuporem quo correptus fuerat cum vento tranſlatus citatiſſimo non perſentiſcere tamen, nempe tam citus erat quam ventus.* Though the Wind were in it ſelf very ſwift and ſtrong, yet to Paſſengers in this Chariot it would not be at all diſcernible, becauſe they did go with an equal Swiftneſs to the Wind it ſelf: Men that ran before it ſeeming to go backwards, Things which ſeem at a great Diſtance being preſently overtaken and left behind. In two Hours Space it would paſs from *Sceveling* to *Putten*, which are diſtant from one another above 14 *Horaria Milliaria*, (ſaith the ſame Author), that is, more than Two and forty Miles.

Pet. Gaſſendus. Vita Peireſkii, l. 2.

Grotius is very copious and elegant in the celebrating of this Invention, and the Author of it in divers Epigrams.

Grotii Poemata, Ep. 19.

Ventivolum Tiphys deduxit in æquora navim,
Jupiter in ſtellas, æthereamque domum.
In terreſtre ſolum virtus Stevinia, nam nec
Tiphy tuum fuerat, nec Jovis iſtud opus.

Ep. 5. And in another Place,

Impoſuit plauſtro vectantem carbaſa, malum
An potius navi, ſubdidit ille rotas?
——Scandit aquas navis currus ruit aere prono,
Et merito dicas hic volat, illa natat.

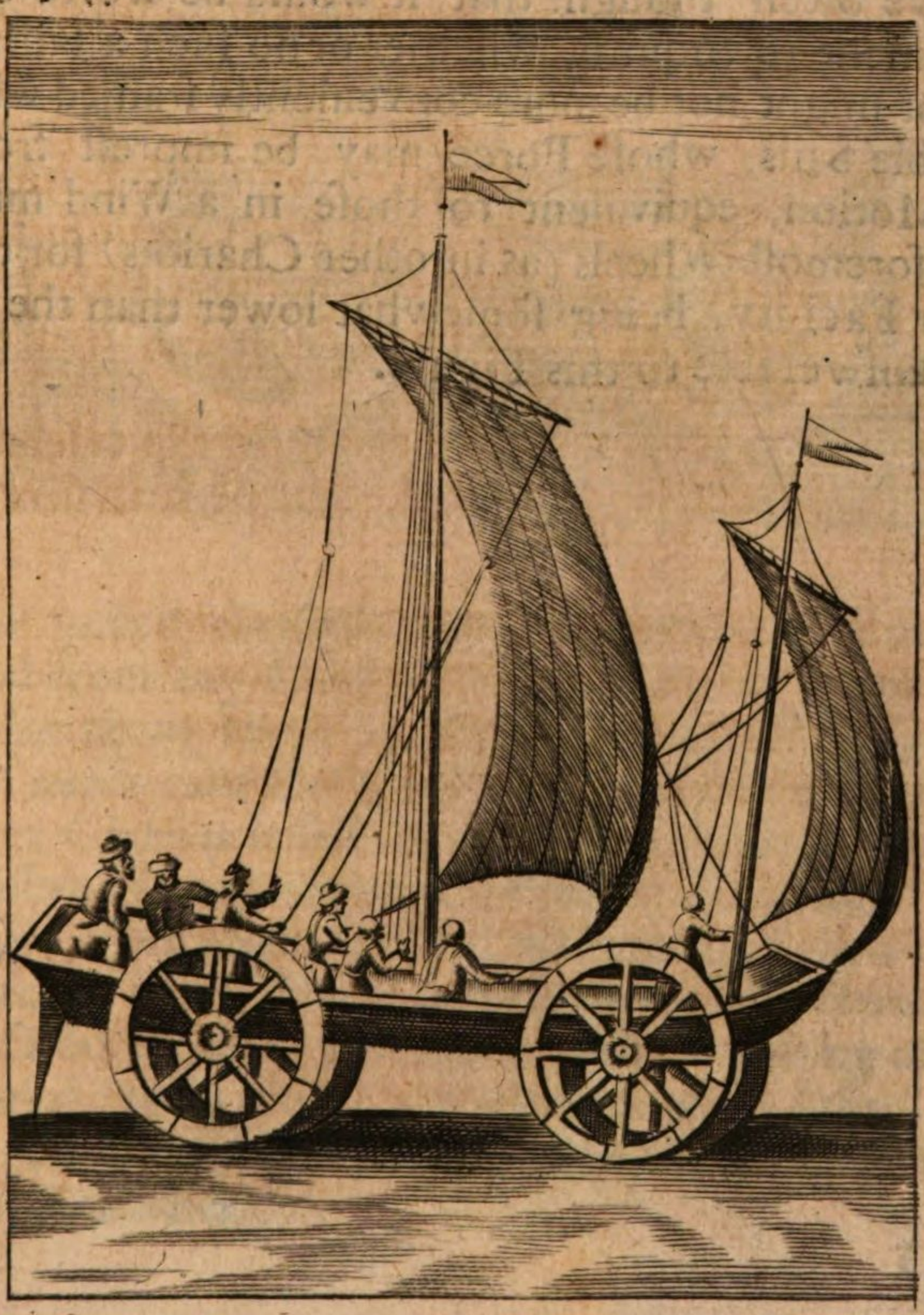
Theſe Relations did at the firſt ſeem unto me, (and

per-

perhaps they will ſo to others)ſomewhat ſtrange & incredible. But upon farther Enquiry, I have heard them frequently atteſted from the particular Eye-ſight and Experience of ſuch eminent Perſons, whoſe Names I dare not cite in a Buſineſs of this Nature, which in thoſe Parts is ſo very common, and little obſerved.

I have not met with any Author who doth treat particularly concerning the Manner of framing this Chariot, tho' *Grotius* mentions an elegant Deſcription of it in Copper by one *Geynius*: And *Hondius* in one of his large Maps of *Aſia*, does give another conjectural Deſcription of the like Chariots uſed in *China*. *Epig.* 20. & 21.

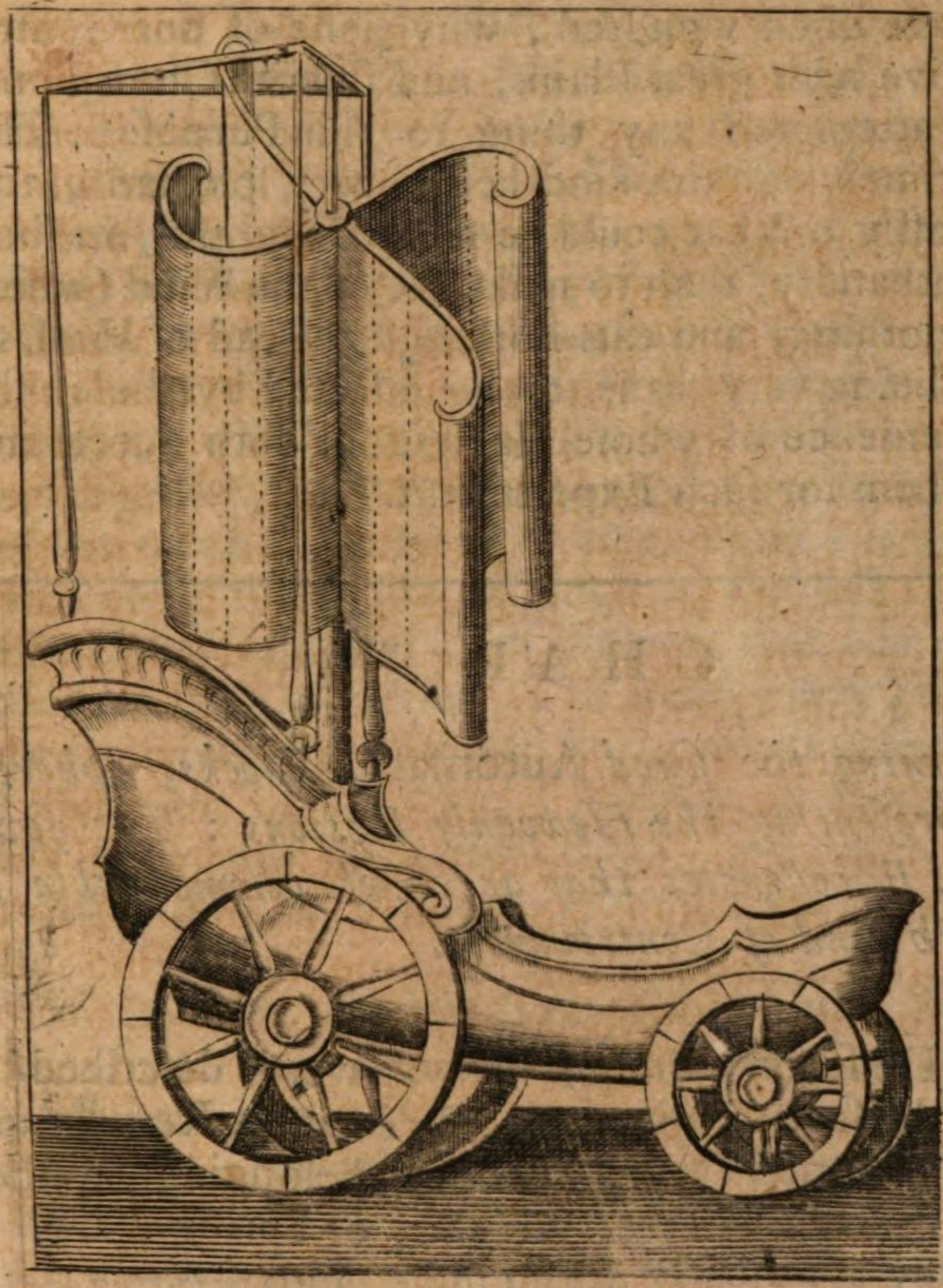
The Form of it is related to be very ſimple and plain, after this manner.



The Body of it being ſomewhat like a Boat, moving upon 4 Wheels of an equal Bigneſs, with two Sails like thoſe in a Ship; there being ſome Contrivance to turn and ſteer it, by moving a Rudder which is placed beyond the two hindmoſt Wheels; and for the ſtopping of it, this muſt be done, either by letting down the Sail, or turning it from the Wind.

Of this kind they have frequently in *Holland* other little Veſſels for one or two Perſons to go upon the Ice, having Sledges inſtead of Wheels, being driven with a Sail; the Bodies of them like little Boats, that if the Ice ſhould break, they might yet ſafely carry a Man upon the Water, where the Sail would be ſtill uſeful for the Motion of it.

I have often thought that it would be worth the Experiment to enquire, whether or no ſuch a ſailing Chariot might not be more conveniently framed with moveable Sails, whoſe Force may be impreſt from their Motion, equivalent to thoſe in a Wind-mill. Their foremoſt Wheels (as in other Chariots) for the greater Facility, being ſomewhat lower than the other, anſwerable to this Figure.



In which the Sails are ſo contrived, that the Wind from any Coaſt will have a Force upon them to turn them about; and the Motion of theſe Sails muſt needs turn the Wheels, and conſequently carry on the Chariot it ſelf to any Place (though fully a-gainſt the Wind) whither it ſhall be directed.

The chief doubt will be, whether in ſuch a Contrivance, every little Ruggedneſs or Unevenneſs of the Ground, will not cauſe ſuch a jolting of the Chariot, as to hinder the Motion of its Sails. But this perhaps (if it ſhould prove ſo) is capable of ſeveral Remedies.

I have

I have often wondred, why none of our Gentry who live near great Plains, and ſmooth Champions, have attempted any thing to this Purpoſe. The Experiments of this kind being very pleaſant, and not coſtly: What could be more delightful, or better Husbandry, than to make uſe of the Wind (which coſts nothing, and eats nothing) inſtead of Horſes? This being very eaſie to be effected by thoſe, the Convenience of whoſe Habitations doth accommodate them for ſuch Experiments.

CHAP. III.

Concerning the fixed Automata, *Clocks, Spheres, repreſenting the Heavenly Motions: The ſeveral Excellencies that are moſt commendable in ſuch kind of Contrivances.*

THe ſecond kind of αὐτόματα were deſcribed to be ſuch Engines, as did receive a Regular and laſting Motion from ſomething belonging to their own Frame, whether Weights, or Springs, &c.

They are uſually diſtinguiſhed into αὐτόματα
- ἕστα, fixed and ſtationary.
- φοιτητικὰ, moveable and tranſient.

1. The fixed are ſuch as move only according to their ſeveral Parts, and not according to their whole Frame; in which, though each Wheel hath a diſtinct Rotation, yet the whole doth ſtill remain unmoved. The chiefeſt Kind of theſe are the Clocks and Watches in ordinary uſe; the framing of which is ſo commonly known by every Mechanick, that I ſhall not trouble the Reader with any Explication of it. He that deſires fuller Satisfaction, may ſee them particularly deſcribed by * *Cardan*, † *D. Flood*, and others.

* *De Varietat. Rer. l. 9. c. 47.*

† *Tract. 2. part. 7. l. 1. cap. 4.*

The

The first Invention of these (saith *Pancirollus*) was taken from that Experiment in the Multiplication of Wheels, mentioned in *Vitruvius*, where he speaks of an Instrument, whereby a Man may know how many Miles or Paces he doth go in any space of Time, whether or no he do pass by Water in a Boat, or Ship, or by Land in a Chariot, or Coach: They have been contrived also into little Pocket-Instruments, by which, after a Man hath walked a whole Day together, he may easily know how many Steps he hath taken. I forbear to enter upon a larger Explication of these kind of Engines, because they are impertinent unto the chief Business that I have proposed for this Discourse. The Reader may see them more particularly described in the above-cited Place of *Vitruvius*, in * *Cardan*, † *Bessonius*, and others; I have here only mentioned them, as being the first occasion of the chiefest ἀυτόματα, that are now in Use.

Repert. Tit. 10. *Architect. l.* 10. *c.* 14.

Of the same kind with our Clocks and Watches (though perhaps more Elaborate, and Subtle) was that Sphere invented by *Archimedes*, which did represent the Heavenly Motions: The Diurnal, and Annual Courses of the Sun, the Changes, and Aspects of the Moon, *&c.* This is frequently celebrated in the Writings of the Ancients, particularly in that known *Epigram* of *Claudian*:

Mentioned by *Cicero. Tuscul. Quæst. l.* 1. *item De Nat. Deorum l.* 2.

Jupiter in parvo cum cerneret æthera vitro,
Risit, & ad superos talia dicta dedit;
Huccine mortalis progressa potentia curæ?
Jam meus in fragili luditur orbe labor.
Jura poli, rerumque fidem, legesque Deorum,
Ecce Syracusius transtulit arte senex.
*Inclusus variis famulatur * spiritus astris,*
Et vivum certis motibus urget opus.
Percurrit proprium mentitus Signifer annum;
Et simulata novo Cynthia mense redit.

* *Subtil. l.* 18. †*Theatrum instrumentorum. Wecker de secretis. l.* 15. *c.* 32.

* The secret force from which the Motion was impressed.

Famq;

Famq; ſuum volvens audax induſtria mundum
Gaudet, & humanâ ſidera mente regit.
Quid falſo inſontem tonitru Salmonea miror?
Æmula naturæ parva reperta manus.

Excellently Tranſlated by *T. Randolph.*

Jove ſaw the Heavens fram'd in a little *Glaſs*,
And Laughing, to the Gods theſe Words did paſs;
Comes then the Power of mortal Cares ſo far?
In brittle Orbs my Labours acted are.
The Statutes of the Poles, the Faith of Things,
The Laws of Gods, this *Syracuſian* brings
Hither by Art: Spirits inclos'd attend
Their ſeveral Spheres, and with ſet Motions bend
The living Work: Each Year the feigned Sun,
Each Month returns the counterfeited Moon.
And viewing now her World, bold Induſtry
Grows Proud, to know the Heavens his Subjects be.
Believe, *Salmoneus* hath falſe Thunders thrown,
For a poor Hand is Nature's Rival grown.

Inſtit. l. 2. c. 5.

But, that this Engine ſhould be made of Glaſs, is ſcarce credible. *Lactantius*, mentioning the Relation of it, affirms it to conſiſt of Braſs, which is more likely. It may be the Outſide, or Caſe was Glaſs, and the Frame it ſelf of Braſs. *Cælius Rhodoginus*, ſpeaking of the wondrous Art in the contrivance of this Sphere, breaks out into this Quære. *Nonne igitur miraculorum omnium, maximum miraculum eſt homo?* He might have ſaid *Mathematicus*: And another to this purpoſe, *Sic manus ejus naturam, ut natura ipſa manum imitata putetur.* *Pappus* tells us, that *Archimedes* writ a Book *de Sphæropœia*, concerning the manner of framing ſuch Engines; and after him, *Poſſidonius* compoſed another Diſcourſe on the ſame Subject; though now either the Ignorance, or the Envy of Time hath deprived us of both thoſe Works.

Antiq. lect. l. 2. c. 16.

Guid Ubaldus præf. ad Mechan.

Collect. Mathem. Proæm. ad l. 8.

And

And yet the Art it ſelf is not quite periſhed, for we read of divers the like Contrivances in theſe latter Times. *Agrippa* affirms, that he himſelf had ſeen ſuch a Sphere; and *Ramus* tells us how he beheld two of them in *Paris*, the one brought thither amongſt other Spoils from *Sicily*, and the other out of *Germany*. And it is commonly reported, that there is yet ſuch a Sphere at *Strasburg* in *Germany*. * *Rivaltus* relates how *Marinus Burgeſius* a *Norman* made two of them in *France* for the King. And perhaps theſe latter (ſaith he) were more Exact than the former, becauſe the Heavenly Revolutions are now much better underſtood than before. And beſides it is queſtionable, whether the uſe of Steel-ſprings was known in thoſe ancient Times; the Application of which unto theſe kind of Spheres, muſt needs be much more convenient than Weights.

De vanit. Scient. c. 22. Schol. Mathem. l. 1. So *Cardan* too, *l.* 17. *Monanth in Mecha. Ariſt Com. c.* 1. *Dr.* Hackwell, *Apol. l.* 3. *c.* 10. *ſect* 1. * *De vita Archimedis.*

'Tis related alſo of the Conſul *Boethius*, that amongſt other Mathematical Contrivances, (for which he was Famous) he made a Sphere to repreſent the Sun's Motion; which was ſo much admired, and talked of in thoſe Times, that *Gundibaldus*, King of *Burgundy*, did purpoſely ſend over Ambaſſadors to *Theodoricus* the Emperor, with Intreaties that he would be a means to procure one of theſe Spheres from *Boethius*; the Emperor thinking hereby to make his Kingdom more Famous and Terrible unto foreign Nations, doth write an Epiſtle to *Boethius*, perſwading him to ſend this Inſtrument. *Quoties non ſunt credituri quod viderint? Quoties hanc veritatem luſoria ſomnia putabunt? Et quanto fuerint à ſtupore converſi, non audebunt ſe æquales nobis dicere, apud quos ſciunt ſapientes talia cogitaſſe.* So much were all theſe kind of Inventions admired in thoſe ruder and darker Times: Whereas the Inſtruments that are now in Uſe amongſt us (though not ſo much Extolled) yet do altogether equal (if not exceed) the other, both in Uſefulneſs and Subtilty. The chiefeſt of theſe former

Caſſiodor. Chron. Pet. Bertius præf ad Conſolat. Philoſ.

former Engines receiving their Motion from Weights, and not from Springs, (which as I said before) are of later and more excellent Invention.

Polyd. Virgil. de Invent. rerum l. 2. c. 5. Cardan Subtil.

The particular Circumstances, for which the *Automata* of this kind are most eminent, may be reduced to these four.

1. The lastingness of their Motion, without needing of any new supply; for which purpose there have been some Watches contrived to continue without winding up for a Week together, or longer.

2. The easiness and simplicity of their Composition; Art it self being but the facilitating and contracting of ordinary Operations; therefore the more easy and compendious such Inventions are, the more artificial should they be esteemed. And the addition of any such unnecessary Parts, as may be supplied some other way, is a sure sign of Unskilfulness and Ignorance. Those antiquated Engines that did consist of such a needless multitude of Wheels, and Springs, and Screws, (like the old *Hypothesis* of the Heavens) may be compared to the Notions of a confused Knowledge, which are always full of Perplexity and Complications, and seldom in Order; whereas the Inventions of Art are more regular, simple, and perspicuous, like the apprehensions of a distinct and thoroughly-informed Judgment. In this respect the manner of framing the ordinary *Automata*, hath been much bettered in these later Times above the former, and shall hereafter perhaps be yet more advantaged. These kind of Experiments (like all other human Arts) receiving Additions from every Days Experiment.

To this purpose there is an Invention consisting only of one hollow Orb or Wheel, whereby the Hours may be as truly distinguished, as by any ordinary Clock or Watch. This Wheel should be divided into several Cavities, through each of which successively either Sand or Water must be contrived

to

to pass; the heavineſs of theſe Bodies (being always in the aſcending ſide of the Wheel) muſt be counterpoiſed by a Plummet that may be faſtned about the Pulley on the Axis: This Plummet will leiſurely deſcend, according as the Sand by running out of one Cavity into the next, doth make the ſeveral parts of the Wheel lighter or heavier, and ſo conſequently there will be produced an equal and laſting Motion, which may be eaſily applied to the diſtinction of Hours.

3. The multitude and variety of thoſe Services for which they may be uſeful. Unto this kind may we refer thoſe Watches by which a Man may tell not only the Hour of the Day, but the Minute of the Hour, the Day of the Month, the Age and Aſpects of the Moon, *&c.* Of this nature likewiſe was that Larum mentioned by *Walchius*, which tho' it were but two or three Inches big, yet would both wake a Man, and of it ſelf light a Candle for him at any ſet Hour of the Night. And thoſe Weights or Springs which are of ſo great Force as to turn a Mill, (as ſome have been contrived) may be eaſily applied to more various and difficult Labours.

Fab. 9.

Ramel. fig. 130.

4. The littleneſs of their Frame. *Nunquam ars magis quam in minimis nota eſt* (ſaith *Aquinas.*) The ſmalneſs of the Engine doth much commend the Skill of the Artificer; to this purpoſe there have been Watches contrived in the form and quantity of a Jewel for the Ear, where the ſtriking of the Minutes may conſtantly whiſper unto us, how our Lives do ſlide away by a ſwift Succeſſion. *Cardan* tells us of a Smith who made a Watch in the Jewel of a Ring, to be worn on the Finger, which did ſhew the Hours, (*non ſolum ſagitta, ſed ictu*) not only by the Hand, but by the Finger too (as I may ſay) by pricking it every Hour.

Jacks no bigger than a Walnut to turn any Joint of Meat.

De ſubtil. l. 2. *item l.* 17.

CHAP. IV.

Of the Moveable and Gradient Automata, *repreſenting the Motions of Living Creatures, various Sounds, of Birds, or Beaſts, and ſome of them Articulate.*

THus much of thoſe *Automata*, which were ſaid to be fixed and ſtationary.

The other kind to be enquired after, are thoſe that are moveable and tranſient, which are deſcribed to be ſuch Engines as move not only according to their ſeveral Parts, but alſo according to their whole Frames. Theſe are again diſtinguiſhable into Two Sorts:

1. *Gradient.*
2. *Volant.*

1. The *Gradient* or *Ambulatory*, are ſuch as require ſome Baſis or Bottom to uphold them in their Motions. Such were thoſe ſtrange Inventions (commonly attributed to *Dædalus*) of ſelf-moving Statues, which (unleſs they were violently detained) would of themſelves run away. * *Ariſtotle* affirms that *Dædalus* did this by putting Quickſilver into them. But this would have been too groſs a way for ſo excellent an Artificer; it is more likely that he did it with Wheels and Weights. Of this kind likewiſe were *Vulcan's Tripodes*, celebrated by *Homer*, that were made to move up and down the Houſe, and fight with one another. He might as well have contrived them into Journey-men Statues, each of which with a Hammer in his Hand ſhould have worked at the Forge.

Plato in Menone. Ariſt. Polit. l. 1 *c.* 3.

* *De Anima l.* 1 *c.* 3. *Iliad.* 18. There have been alſo Chariots driven by the force of a Spring contrived within them. *De Variet. Rerum l.* 12. *c.* 58.

But amongſt theſe fighting Images, that in *Cardan* may deſerve a mention, which holding in its Hand

Hand a Golden Apple, beautified with many coſtly Jewels; if any Man offered to take it, the Statue preſently ſhot him to Death. The touching of this Apple ſerving to diſcharge ſeveral ſhort Bows, or other the like Inſtruments that were ſecretly couched within the Body of the Image. By ſuch a Treachery was King *Chennettus* murdered (as *Boetius* relates.)

It is ſo common an Experiment in theſe Times to repreſent the Perſons and Actions of any Story by ſuch ſelf-moving Images, that I ſhall not need to explain the Manner how the Wheels and Springs are contrived within them.

Amongſt theſe Gradient *Automata*, that Iron-Spider mentioned in *Wulchius*, is more eſpecially remarkable, which being but of an ordinary Bigneſs, beſides the outward Similitude, (which was very exact) had the ſame kind of Motions with a living Spider, and did creep up and down as if it had been alive. It muſt needs argue a wonderful Art and Accurateneſs, to contrive all the Inſtruments requiſite for ſuch a Motion in ſo ſmall a Frame.

Fab. 9. There have been other Inventions to move on the Water. *Navigium ſponte mobile, ac ſui remigii autorem, faciam nullo negotio,* ſaith *Scaliger, Exerc.* 326.

There have been alſo other Motions contrived from Magnetical Qualities, which will ſhew the more wonderful, becauſe there is no apparent Reaſon of their Motion, there being not the leaſt Contiguity or Dependance upon any other Body that may occaſion it; but it is all one as if they ſhould move up and down in the open Air. Get a Glaſs Sphere, fill it with ſuch Liquors as may be clear of the ſame Colour, immixable, ſuch as are Oyl of Tartar, and Spirit of Wine: In which, it is eaſie ſo to poiſe a little Globe or other Statue, that it ſhall ſwim in the Center. Under this Glaſs Sphere, there ſhould be a Loadſtone concealed, by the Motion of which, this Statue (having a Needle touched within it) will move up and down, and may be contrived to ſhew the Hour or Sign. See ſeveral Inventions of this Kind in *Kircher de Arte Magnetica, l.* 2.

There have been ſome artificial Images, which beſides their ſeveral Poſtures in walking up and down, have been made alſo to give ſeveral Sounds, whether of Birds, as Larks, Cuckoes, *&c.* or Beaſts, as Hares, Foxes. The Voices of which Creatures ſhall be rendred as clearly and diſtinctly by theſe artificial Images, as they are by thoſe natural living Bodies, which they repreſent.

There have been ſome Inventions alſo which have been able for the Utterance of articulate Sounds, as the Speaking of certain Words. Such are ſome of the *Egyptian* Idols related to be. Such was the Brazen Head made by Friar *Bacon*, and that Statue, in the framing of which *Albertus Magnus* beſtowed 30 Years, broken by *Aquinas*, who came to ſee it, purpoſely that he might boaſt, how in one Minute he had ruined the Labour of ſo many Years.

Cæl. Rhod. lect. Ant. l. 2. c. 17. Maiolus Colloq.

Now the Ground and Reaſon how theſe Sounds were contrived, may be worth our Enquiry.

Firſt then, for thoſe of Birds or Beaſts, they were made from ſuch Pipes or Calls, as may expreſs the ſeveral Tones of thoſe Creatures which are repreſented: Theſe Calls are ſo commonly known and uſed, that they need not any further Explication.

But now, about articulate Sounds there is much greater Difficulty. *Walchius* thinks it poſſible entirely to preſerve the Voice, or any Words ſpoken in a hollow Trunk, or Pipe, and that this Pipe being rightly opened, the Words will come out of it in the ſame Order wherein they were ſpoken. Somewhat like that cold Countrey, where the Peoples diſcourſe doth freeze in the Air all Winter, and may be heard the next Summer, or at a great Thaw. But this Conjecture will need no Refutation.

Fab. 9.

The more ſubſtantial Way for ſuch a Diſcovery, is by marking how Nature her ſelf doth employ the ſeveral Inſtruments of Speech, the Tongue, Lips, Throat,

Throat, Teeth, *&c.* To this purpoſe the *Hebrews* have aſſigned each Letter unto its proper Inſtrument. And beſides, we ſhould obſerve what inarticulate Sounds do reſemble any of the particular Letters. Thus we may note the trembling of Water to be like the Letter *L*, the quenching of hot things to the Letter *Z*, the ſound of Strings, unto the Letters *Ng*, the jirking of a Switch the Letter *Q*, &c. By an exact Obſervation of theſe Particulars, it is (perhaps) poſſible to make a Statue ſpeak ſome Words.

Bacon. Nat. hiſt. exper. 139. 200.

CHAP. V.

Concerning the Poſſibility of Framing an Ark for Submarine Navigations. The Difficulties and Conveniences of ſuch a Contrivance.

IT will not be altogether impertinent unto the Diſcourſe of theſe gradient *Automata*, to mention what *Merſennus* doth ſo largely and pleaſantly deſcant upon, concerning the making of a Ship, wherein Men may ſafely ſwim under the Water.

Tract. de Magnetis Proprietatibus.

That ſuch a Contrivance is feaſible and may be effected, is beyond all Queſtion, becauſe it hath been already experimented here in *England* by *Cornelius Dreble*; but how to improve it unto Publick Uſe and Advantage, ſo as to be ſerviceable for remote Voyages, the carrying of any conſiderable Number of Men, with Proviſions and Commodities, would be of ſuch excellent Uſe, as may deſerve ſome further Enquiry.

Concerning which there are two things chiefly conſiderable:

The { many Difficulties with their Remedies.
great Conveniences.

1. The Difficulties are generally reducible to these Three Heads.

1. The letting out, or receiving in any thing, as there shall be occasion without the Admission of Water. If it have not such a Convenience, these kind of Voyages must needs be very dangerous and uncomfortable, both by Reason of many noisome, offensive Things, which should be thrust out, and many other needful Things which should be receiv'd in. Now herein will consist the Difficulty, how to contrive the opening of this Vessel so, that any thing may be put in or out, and yet the Water not rush into it with much Violence, as it doth usually in the Leak of a Ship.

In which Case, this may be a proper Remedy; let there be certain Leather Bags made of several Bignesses, which for the Matter of them should be both *tractable* for the Use and Managing of them, and strong to keep out the Water; for the Figure of them, being long and open at both Ends. Answerable to these, let there be divers Windows, or open Places in the Frame of the Ship, round the Sides of which one End of these Bags may be fixed, the other End coming within the Ship, being to open and shut as a Purse. Now if we suppose this Bag thus fastned, to be tied close about towards the Window, then any thing that is to be sent out, may be safely put into that End within the Ship, which being again close shut, and the other End loosened, the thing may be safely sent out without the Admission of any Water.

So again, when any thing is to be taken in, it must be first receiv'd into that Part of the Bag towards the Window, which being (after the thing is with-

within it) close tied about, the other end may then be safely opened. It is easie to conceive, how by this means any Thing or Person may be sent out, or receiv'd in, as there shall be occasion; how the Water, which will perhaps by Degrees leak into several Parts, may be emptied out again, with divers the like Advantages. Tho' if there should be any Leak at the Bottom of this Vessel, yet very little Water would get in, because no Air could get out.

2. The second Difficulty in such an Ark will be the Motion or fixing of it according to occasion: The directing of it to several Places, as the Voyage shall be designed, without which, it would be very useless, if it were to remain only in one Place, or were to remove only blindfold, without any certain Direction: And the Contrivance of this may seem very difficult, because these submarine Navigators will want the usual Advantages of Winds and Tides for Motion, and the Sight of the Heavens for Direction.

But these Difficulties may be thus remedied; As for the *Progressive* Motion of it, this may be effected by the Help of several Oars, which in the outward Ends of them, shall be like the Fins of a Fish to contract and dilate. The Passage where they are admitted into the Ship being tied about with such Leather Bags (as were mentioned before) to keep out the Water. It will not be convenient perhaps that the Motion in these Voyages should be very swift, because of those Observations and Discoveries to be made at the Bottom of the Sea, which in a little space may abundantly recompense the Slowness of its Progress.

If this Ark be so ballast as to be of equal Weight with the like Magnitude of Water, it will then be easily moveable in any Part of it.

As for the Ascent of it, this may be easily contrived, if there be some great Weight at the Bottom

of the Ship (being part of its Ballaſt) which by ſome Cord within may be looſened from it: As this Weight is let lower, ſo will the Ship aſcend from it (if need be) to the very Surface of the Water; and again, as it is pulled cloſe to the Ship, ſo will it *deſcend*.

For *Direction* of this Ark, the Mariners Needle may be uſeful in reſpect of the *Latitude* of Places; and the Courſe of this Ship being more regular than others, by reaſon it is not ſubject to Tempeſts or unequal Winds, may more certainly guide them in judging of the *Longitude* of Places.

3. But the greateſt Difficulty of all will be this, how the Air may be ſupplied for Reſpiration: How conſtant Fires may be kept in it for Light and the Dreſſing of Food, how thoſe Viciſſitudes of Rarefaction and Condenſation may be maintained.

It is obſerved, that a Barrel or Cap, whoſe Cavity will contain Eight Cubical Feet of Air, will not ſerve a Urinator or Diver for Reſpiration, above one quarter of an Hour; the Breath which is often ſucked in and out, being ſo corrupted by the mixture of Vapours, that Nature rejects it as unſerviceable. Now in an Hour a Man will need at leaſt 300 and Sixty Reſpirations, betwixt every one of which there ſhall be 10 ſecond Minutes, and conſequently a great Change and Supply of Air will be neceſſary for many Perſons, and any long Space.

And ſo likewiſe for the keeping of Fire; a cloſe Veſſel containing 10 Cubical Feet of Air, will not ſuffer a Wax Candle of an Ounce to burn in it above an Hour before it be ſuffocated; tho' this Proportion (ſaith *Merſennus*) doth not equally increaſe for ſeveral Lights, becauſe Four Flames of an equal Magnitude will be kept alive the Space of 16 ſecond Minutes, tho' one of theſe Flames alone in the ſame Veſſel will not laſt above 35, or at moſt 30 ſeconds; which may be eaſily tried in large glaſs Bottles, having Wax Candles lighted in them, and with their Mouths inverted in Water.

For

For the Resolution of this Difficulty, though I will not say, that a Man may, by Custom (which in other things doth produce such strange incredible Effects) be enabled to live in the open Water, as the Fishes do, the Inspiration and Expiration of Water serving instead of Air, this being usual with many Fishes that have Lungs; yet it is certain, that long Use and Custom may strengthen Men against many such Inconveniencies of this kind, which to unexperienced Persons may prove very hazardous: And so it will not perhaps be unto these so necessary, to have the Air for breathing so pure and defecated, as is required for others.

But further, there are in this Case these Three Things considerable.

1. That the Vessel it self should be of a large Capacity, that as the Air in it is corrupted in one part, so it may be purified and renewed in the other: Or if the meer Refrigeration of the Air would fit it for Breathing, this might be somewhat helped with Bellows, which would cool it by Motion.

2. It is not altogether improbable, that the Lamps or Fires in the Middle of it, like the reflected Beams in the first Region, rarefying the Air, and the circumambient Coldness towards the sides of the Vessel, like the second Region, cooling and condensing of it, would make such a Vicissitude and Change of Air, as might fit it for all its proper Uses.

3. Or if neither of these Conjectures will help, yet *Mersennus* tells us in another Place, that there is in *France* one *Barrieus* a Diver, who hath lately found out another Art, whereby a Man might easily continue under Water for six Hours together; and whereas Ten Cubical Feet of Air will not serve another Diver to breathe in for half an Hour, he by the Help of a Cavity, not above one or two Foot at most, will have Breath enough for six Hours, and a Lanthorn scarce above the usual Size to keep a Can-

Harmon. l. 4. prop. 6. Monit. 5.

Candle burning as long as a Man pleaſe, which (if it be true, and were commonly known) might be a ſufficient Help againſt this greateſt Difficulty.

As for the many Advantages and Conveniences of ſuch a Contrivance, it is not eaſie to recite them.

1. 'Tis *Private*; a Man may thus go to any Coaſt of the World inviſibly, without being diſcovered or prevented in his Journey.

2. 'Tis *Safe*; from the Uncertainty of *Tides*, and the Violence of *Tempeſts*, which do never move the Sea above Five or Six Paces deep. From *Pirates* and *Robbers* which do ſo infeſt other Voyages: From Ice and great Froſts, which do ſo much endanger the Paſſages towards the Poles.

3. It may be of very great Advantage againſt a Navy of Enemies, who by this means may be undermined in the Water, and blown up.

4. It may be of ſpecial uſe for the Relief of any Place that is Beſieged by Water, to convey unto them Inviſible Supplies; and ſo likewiſe for the Surprizal of any Place that is acceſſible by Water.

5. It may be of unſpeakable Benefit for Submarine Experiments and Diſcoveries; as,

The ſeveral Proportions of Swiftneſs betwixt the aſcent of a Bladder, Cork, or any other light Subſtance, in compariſon to the deſcent of Stones or Lead. The deep Caverns, and Subterraneous Paſſages, where the Sea-water, in the Courſe of its Circulation, doth vent it ſelf into other Places, and the like. The Nature and Kinds of Fiſhes, the ſeveral Arts of Catching them, by alluring them with Lights, by placing divers Nets about the Sides of this Veſſel, ſhooting the greater ſort of them with Guns, which may be put out of the Ship by the help of ſuch Bags as were mentioned before, with divers the like Artifices and Treacheries, which may be more ſucceſsfully practiſed by ſuch who live ſo

familiarly together. Theſe Fiſh may ſerve not only for Food, but for Fewel likewiſe, in reſpect of that Oil which may be extracted from them; the way of Dreſſing Meat by Lamps, being in many Reſpects the moſt convenient for ſuch a Voyage.

The many freſh Springs that may probably be met with in the bottom of the Sea, will ſerve for the Supply of Drink, and other Occaſions.

But above all, the Diſcovery of ſubmarine Treaſures is more eſpecially conſiderable; not only in regard of what hath been drowned by Wrecks, but the ſeveral precious Things that grow there; as Pearl, Coral, Mines; with innumerable other Things of great Value, which may be much more eaſily found out, and fetch'd up by the help of this, than by any other uſual way of the Urinators.

To which purpoſe, this great Veſſel may have ſome leſſer Cabins tyed about it, at various Diſtances; wherein ſeveral Perſons, as Scouts, may be lodged for the taking of Obſervations, according as the Admiral ſhall direct them: Some of them being frequently ſent up to the Surface of the Water, as there ſhall be Occaſion.

All kind of Arts and Manufactures may be exerciſed in this Veſſel. The Obſervations made by it, may be both Written, and (if need were) Printed here likewiſe. Several Colonies may thus inhabit, having their Children born, and bred up without the knowledge of Land, who could not chuſe but be amazed with ſtrange Conceits upon the Diſcovery of this Upper World.

I am not able to judge what other Advantages there may be ſuggeſted, or whether Experiment would fully anſwer to theſe Notional Conjectures. But however, becauſe the Invention did unto me ſeem ingenious and new, being not impertinent to the preſent Enquiry, therefore I thought it might be worth the mentioning.

CHAP.

CHAP. VI.

Of the volant Automata, Archytas *his Dove, and* Regiomontanus *his Eagle. The Possibility, and great Usefulness of such Inventions.*

THE *volant*, or flying *Automata*, are such Mechanical Contrivances as have a Self-motion, whereby they are carried aloft in the open Air like the flight of Birds. Such was that Wooden Dove made by *Archytas*, a Citizen of *Tarentum*, and one of *Plato*'s Acquaintance: And that Wooden Eagle framed by *Regiomontanus* at *Noremberg*, which, by way of Triumph, did fly out of the City to meet *Charles* the Fifth. This latter Author is also reported to have made an Iron Fly, *Quæ ex artificis manu egressa, convivas circumvolitavit, tandemque veluti defessa in Domini manus reversa est*; which, when he invited any of his Friends, would fly to each of them round the Table, and at length (as being weary) return unto its Master.

Diog. Laer. l. 8.

Pet. Crinitus de honest. discip. l. 17. c. 12.

Ramus Schol. Mathem. l. 2.

Dabartas 6 days 1 W. l. Dee Preface to *Euclid.*

Cardan seems to doubt the possibility of any such Contrivance: His Reason is, because the Instruments of it must be firm and strong, and consequently they will be too heavy to be carried by their own force; but yet (saith he) if it be a little helped in the first rising, and if there be any Wind to assist it in the Flight, then there is nothing to hinder, but that such Motions may be possible. So that he doth in effect grant as much as may be sufficient for the Truth and Credit of those ancient Relations; and to distrust them without a stronger Argument, must needs argue a blind and perverse Incredibility. As for his Objection concerning the heavinesss of the Materials in such an Invention, it may be answered,

De Varietate rerum lib. 12. c. 58.

That

That it is eaſie to contrive ſuch Springs, and other Inſtruments, whoſe Strength ſhall much exceed their Heavineſs. Nor can he ſhew any cauſe why theſe Mechanical Motions may not be as ſtrong, (though not ſo laſting) as the natural Strength of Living Creatures.

Scaliger conceives the framing of ſuch volant *Automata* to be very eaſie. *Volantis columbæ machinulam, cujus autorem Archytam tradunt, vel facillime profiteri audeo.* Thoſe ancient Motions were thought to be contrived by the force of ſome included Air: So *Gellius*, *Ita erat ſcilicet libramentis ſuſpenſum, & aurâ ſpiritus incluſa, atque occultà conſitum, &c.* As if there had been ſome Lamp, or other Fire within it, which might produce ſuch a forcible Rarefaction, as ſhould give a Motion to the whole Frame.

Subtil. Exercit. 326.

Noct. Attic. l. 10. cap. 12. where he thinks it ſo ſtrange an Invention, that he ſtiles it *Res abhorrens a fide. Athan. Kircher de Magnete l. 2. par. 4. Proem.* doth promiſe a large Diſcourſe concerning theſe kind of Inventions in another Treatiſe, which he ſtiles *Oedipus Aegyptiacus.*

But this may be better performed by the ſtrength of ſome ſuch Spring, as is commonly uſed in Watches. This Spring may be applied unto one Wheel, which ſhall give an equal Motion to both the Wings; theſe Wings having unto each of them another ſmaller Spring, by which they may be contracted and lifted up: So that being forcibly depreſſed by the ſtrength of the great and ſtronger Spring, and lifted up again by the other two; according to this Suppoſition, it is eaſie to conceive how the Motion of Flight may be performed and continued.

The Wings may be made either of *ſeveral Subſtances joined*, like the Feathers in ordinary Fowl, as *Dædalus* is feigned to contrive them, according to that in the Poet,

---Ignotas animum dimittit in artes,
Naturamque novat, nam ponit in ordine pennas
A minimo cœptas longam breviore ſequente,
Ut clivo creviſſe putes, &c.

Ovid. Metam. l. 8.

Or elſe of *one continuate Subſtance*, like thoſe of Bats. In framing of both which, the beſt Guidance is to follow (as near as may be) the Direction of Nature,

ture, this being but an Imitation of a Natural Work. Now in both theſe, the ſtrength of each part is proportioned to the force of its Employment. But nothing in this kind can be perfectly determined without a particular Trial.

Though the compoſing of ſuch Motions may be a ſufficient Reward to any one's Induſtry in the ſearching after them, as being in themſelves of excellent Curioſity, yet there are ſome other Inventions depend upon them of more general Benefit, and greater Importance. For, if there be any ſuch artificial Contrivances that can fly in the Air, (as is evident from the former Relations, together with the Grounds here ſpecified, and, I doubt not, may be eaſily effected by a diligent and ingenious Artificer) then it will clearly follow, that it is poſſible alſo for a Man to fly himſelf; it being eaſie from the ſame Grounds, to frame an Inſtrument wherein any one may ſit, and give ſuch a Motion unto it, as ſhall convey him aloft through the Air. Than which there is not any imaginable Invention, that could prove of greater Benefit to the World, or Glory to the Author; and therefore it may juſtly deſerve their Enquiry, who have both Leiſure and Means for ſuch Experiments.

But in theſe practical Studies, unleſs a Man be able to go the Tryal of Things, he will perform but little. In ſuch Matters,

Horace. ---*Studium ſine divite venâ*,

(as the Poet ſaith) a general Speculation, without particular Experiment, may conjecture at many things, but can certainly effect nothing; and therefore I ſhall only propoſe unto the World, the Theory and general Grounds that may conduce to the eaſie and more perfect Diſcovery of the Subject in Queſtion, for the Encouragement of thoſe that have both Minds and Means for ſuch Experiments. This ſame Scholar's Fate,

Res

Res anguſta domi, and
---*Curta ſuppellex*,
is that which hinders the promoting of Learning in ſundry Particulars, and robs the World of many excellent Inventions. We read of *Ariſtotle*, that he was allowed by his Pupil *Alexander* 800 Talents a Year, for the Payment of Fiſhers, Fowlers, and Hunters, who were to bring him in ſeveral Creatures, that ſo by his particular Experience of their Parts and Diſpoſitions, he might be more fitly prepared to write of their Natures. The Reaſon why the World hath not many *Ariſtotles*, is becauſe it hath ſo few *Alexanders*.

Amongſt other Impediments of any ſtrange Invention, or Attempts, it is none of the meaneſt Diſcouragements, that they are ſo generally derided by common Opinion; being eſteemed only as the Dreams of a melancholy and diſtempered Fancy. *Euſebius* ſpeaking, with what neceſſity every thing is confined by the Laws of Nature, and the Decrees of Providence, ſo that nothing can go out of that way unto which naturally it is deſigned; as a Fiſh cannot reſide on the Land, nor a Man in the Water, or aloft in the Air; infers, that therefore none will venture upon any ſuch vain Attempt, as paſſing in the Air, ἢ μελαγχολίας νοσήματα ἂν φθέγξοι, unleſs his Brain be a little crazed with the Humour of Melancholy; whereupon he adviſes, that we ſhould not in any Particular, endeavour to tranſgreſs the Bounds of Nature, ἐπεὶ ἄπτερον ἔχοντα τὸ σῶμα, τὰ τῶν πτηνῶν ἐπιδεύειν, and ſince we are deſtitute of Wings, not to imitate the Flight of Birds. That Saying of the Poet,

Demens, qui nimbos, & non imitabile fulmen, &c. hath been an old Cenſure, applyed unto ſuch as ventured upon any ſtrange or incredible Attempt.

Contra Hieroclem. confut. l. 1.

Virgil Æneid. l. 6.

Hence may we conceive the Reaſon, why there is ſo little Intimation in the Writings of Antiquity, con-

concerning the poſſibility of any ſuch Invention. The Ancients durſt not ſo much as mention the Art of Flying, but in a Fable.

Dædalus, ut fama eſt, fugiens Minoia regna,
Præpetibus pennis auſus ſe credere cœlo,
Inſuetum per iter gelidas enavit ad arctos, &c.

It was the Cuſtom of thoſe former Ages, in their over-much Gratitude, to advance the firſt Authors of any uſeful Diſcovery amongſt the Number of their Gods. And *Dædalus*, being ſo famous amongſt them for ſundry Mechanical Inventions (eſpecially the Sails of Ships) though they did not for theſe place him in the Heavens, yet they have promoted him as near as they could, feigning him to fly aloft in the Air, when as he did but fly in a ſwift Ship, as *Diodorus* relates the Hiſtorical Truth on which that Fiction is grounded.

So *Euſebius* too.

CHAP. VII.

Concerning the Art of Flying. The ſeveral ways whereby this hath been, or may be attempted.

I Have formerly in two other * Diſcourſes mentioned the poſſibility of this Art of Flying, and intimated a farther Enquiry into it, which is a kind of Engagement to ſome fuller Diſquiſitions and Conjectures to that purpoſe.

There are four ſeveral ways whereby this Flying in the Air hath been, or may be attempted. Two of them by the ſtrength of other things, and two of them by our own Strength.

1. By Spirits, or Angels.
2. By the help of Fowls.
3. By Wings faſtned immediately to the Body.
4. By a Flying Chariot.

*World in the Moon, *cap.* 14. *Mercury*, or the Secret and Swift Meſſenger, *c.* 4.

1. For

1. For the first, we read of divers that have passed swiftly in the Air, by the help of Spirits and Angels; whether good Angels, as * *Elias* was carried unto Heaven in a Fiery-Chariot, as † *Philip* was conveyed to *Azotus*, and *Habakkuk* from *Jewry* to *Babylon*, and back again immediately: Or by evil Angels, as our Saviour was carried by the Devil to the top of a high Mountain, and to the Pinacle of the Temple. Thus Witches are commonly related to pass unto their usual Meetings, in some remote Place; and, as they do sell Winds unto Mariners, so likewise are they sometimes hired to carry Men speedily through the open Air. *Acosta* affirms, that such kind of Passages are usual amongst divers Sorcerers with the *Indians* at this day.

Zanch. de oper. part 1. *l.* 4.
* 2 Kings 2. 11.
† Acts 8. 39.
Dan. Apoc. 39.
Luke 4.
Erastus de Lamus.
Hist. Ind. l. 5. *c.* 26

So *Kepler*, in his Astronomical Dream, doth fancy a Witch to be conveyed unto the Moon by her Familiar.

Simon Magus was so eminent for Miraculous Sorceries, that all the People in *Samaria*, from the least to the greatest, did esteem him *as the great Power of God*. And so famous was he at *Rome*, that the Emperor erected a Statue to him with this Inscription, *Simoni Deo Sancto*. 'Tis storied of this Magician, that having challenged St. *Peter* to do Miracles with him, he attempted to fly from the Capitol to the *Aventine* Hill; but when he was in the midst of the way, St. *Peter*'s Prayers did overcome his Sorceries, and violently bring him to the Ground; in which Fall having broke his Thigh, within a while after he Died.

Acts 8. 10
Hegesip. l. 3. *c.* 2.
Pol. Virgil. de Inven. Rerum. l. 8. *c.* 3.
Pet. Crinitus de Honestâ Disciplin. l. 8. *c.* 1. mistrusts this Relation as fabulous.

But none of all these Relations may conduce to the Discovery of this Experiment, as it is here enquired after, upon *Natural* and *Artificial* Grounds.

2. There are others, who have conjectured a possibility of being conveyed through the Air by the help of Fowls; to which purpose, that Fiction of the *Ganza's* is the most pleasant and probable. They

Non enim Lucas hoc omisisset.

are ſuppoſed to be great Fowl, of a ſtrong laſting Flight, and eaſily tameable: Divers of which may be ſo brought up, as to join together in the carrying the weight of a Man, ſo as each of them ſhall partake his proportionable ſhare of the Burden, and the Perſon that is carried may by certain Reins, direct and ſteer them in their Courſes. However this may ſeem a ſtrange Propoſal, yet it is not certainly more improbable than many other Arts, wherein the Induſtry of Ingenious Men hath inſtructed theſe Brute Creatures. And I am very confident, that one whoſe Genius doth enable him for ſuch kind of Experiments upon Leiſure, and the advantage of ſuch Helps as are requiſite for various and frequent Trials, might effect ſome ſtrange things by this kind of Enquiry.

'Tis reported as a Cuſtom amongſt the *Leucatians*, that they were wont upon a Superſtition, to precipitate a Man from ſome high Cliff into the Sea, tying about him with Strings at ſome diſtance, many great Fowls, and fixing upon his Body divers Feathers, ſpread to break the Fall; which (ſaith the Learned *Bacon*, if it were diligently and exactly contrived) would be able to hold up, and carry any proportionable Weight; and therefore he adviſes others to think further upon this Experiment, as giving ſome Light to the Invention of the Art of Flying.

Nat. Hiſt. Experim. 886.

3. 'Tis the more obvious and common Opinion, that this may be effected by Wings faſtned immediately to the Body, this coming neareſt to the Imitation of Nature, which ſhould be obſerved in ſuch Attempts as theſe. This is that way which *Fredericus Hermannus*, in his little Diſcourſe *de Arte volandi*, doth only mention and inſiſt upon; and if we may truſt credible Story, it hath been frequently attempted not without ſome Succeſs. 'Tis related of a certain *Engliſh* Monk, called *Elmerus*, about the Con-

So the ancient *Britiſh Bladuds.*

feſſor's

feſſor's time, that he did by ſuch Wings fly from a Tower above a Furlong; and ſo another from Saint *Mark*'s Steeple in *Venice*; another at *Norinberg*; and *Busbequius* ſpeaks of a *Turk* in *Conſtantinople*, who attempted ſomething this way. M. *Burton* mentioning this Quotation, doth believe that ſome new-fangled Wit (*'tis his Cynical Phraſe*) will ſome time or other find out this Art. Though the truth is, moſt of theſe Artiſts did unfortunately miſcarry by falling down, and breaking their Arms or Legs, yet that may be imputed to their want of Experience, and too much Fear, which muſt needs poſſeſs Men in ſuch dangerous and ſtrange Attempts. Thoſe things that ſeem very difficult and fearful at the firſt, may grow very facil after frequent Trial and Exerciſe: And therefore he that would effect any thing in this kind, muſt be brought up to the conſtant practice of it from his Youth; trying firſt only to uſe his Wings, in running on the Ground, as an Eſtrich or tame Geeſe will do, touching the Earth with his Toes; and ſo by degrees learn to riſe higher, till he ſhall attain unto Skill and Confidence. I have heard it from credible Teſtimony, that one of our own Nation hath proceeded ſo far in this Experiment, that he was able by the help of Wings, in ſuch a running Pace, to ſtep conſtantly ten Yards at a time.

Erneſtus Burgravus in Panoplia Phyſico-Vulcania. Sturmius in Lat. linguæ reſolut.

Melancholy, *Par.* 2. *Sect.* 1. *Mem.* 3.

It is not more incredible, that frequent Practice and Cuſtom ſhould enable a Man for this, than for many other things which we ſee confirmed by Experience. What ſtrange Agility and Activeneſs do our common Tumblers and Dancers on the Rope attain to by continual Exerciſe? 'Tis related of certain *Indians*, that they are able, when a Horſe is running in his full Career, to ſtand upright on his Back, to turn themſelves round, to leap down, gathering up any thing from the Ground, and immediately to leap up again, to ſhoot exactly at any

Maffæus Hiſt. Ind. l. 1.

Mark, the Horſe not intermitting his Courſe: And ſo upon two Horſes together, the Man ſetting one of his Feet upon each of them. Theſe things may ſeem impoſſible to others, and it would be very dangerous for any one to attempt them, who hath not firſt gradually attained to theſe Arts by long Practice and Trial; and why may not ſuch Practice enable him as well for this other Experiment, as for theſe Things?

There are others, who have invented ways to walk upon the Water as regularly and firmly as upon the Land. There are ſome ſo accuſtomed to this Element, that it hath been almoſt as natural to them as to the Fiſh; Men that could remain for above an Hour together under Water. *Pontanus* mentions one, who could ſwim above a hundred Miles together, from one Shoar to another, with great ſpeed, and at all times of the Year. And it is ſtoried of a certain young Man, a *Sicilian* by Birth, and a *Diver* by Profeſſion, who had ſo continually uſed himſelf to the Water, that he could not enjoy his Health out of it. If at any time he ſtaid with his Friends on the Land, he ſhould be ſo tormented with a Pain in his Stomach, that he was forced for his Health to return back again to Sea; wherein he kept his uſual Reſidence, and when he ſaw any Ships, his Cuſtom was to ſwim to them for Relief; which kind of Life he continued till he was an old Man, and died.

Treatiſe of Cuſtom.

I mention theſe things, to ſhew the great Power of Practice and Cuſtom, which might more probably ſucceed in this Experiment of Flying (if it were but regularly attempted) than in ſuch ſtrange Effects as theſe.

It is a uſual Practice in theſe Times, for our *Funambulones*, or Dancers on the Rope, to attempt ſomewhat like to Flying, when they will with their Heads forwards, ſlide down a long Cord extended; being

being faſtned at one end to the top of ſome high Tower, and the other at ſome diſtance on the Ground, with Wings fixed to their Shoulders, by the ſhaking of which they will break the force of their Deſcent. It would ſeem that ſome attempts of this kind were uſual amongſt the *Romans*. To which that Expreſſion in * *Salvian* may refer; where, amongſt other publick Shews of the Theatre, he mentions the *Petaminaria*; which Word (ſaith *Jo. Braſſicanus*) is ſcarce to be found in any other Author, being not mentioned either in *Julius Pollux*, or *Politian*. 'Tis probably derived from the *Greek* word πέτομαι, which ſignifies to Fly, and may refer to ſuch kind of Rope-Dancers.

* *De guber. Dei. l. 6. Annot. in Salvi.*

But now, becauſe the Arms extended are but weak, and eaſily wearied, therefore the Motions by them are like to be but ſhort and ſlow, anſwerable it may be to the Flight of ſuch Domeſtick Fowl as are moſt converſant on the Ground, which of themſelves we ſee are quickly weary; and therefore much more would the Arm of a Man, as being not naturally deſigned to ſuch a Motion.

It were therefore worth the Enquiry, to conſider whether this might not be more probably effected by the Labour of the Feet, which are naturally more ſtrong and indefatigable: In which Contrivance, the Wings ſhould come down from the Shoulders on each ſide, as in the other, but the Motion of them ſhould be from the Legs, being thruſt out, and drawn in again one after another, ſo as each Leg ſhould move both Wings; by which means a Man ſhould (as it were) walk or climb up into the Air; and then the Hands and Arms might be at leiſure to help and direct the Motion, or for any other Service proportionable to their Strength. Which Conjecture is not without good Probability, and ſome ſpecial Advantages above the other.

4. But the fourth and laſt way ſeems unto me altogether as probable, and much more uſeful than any of the reſt. And that is by a flying Chariot, which may be ſo contrived as to carry a Man within it; and though the ſtrength of a Spring might perhaps be ſerviceable for the Motion of this Engine, yet it were better to have it aſſiſted by the Labour of ſome intelligent Mover, as the Heavenly Orbs are ſuppoſed to be turned. And therefore if it were made big enough to carry ſundry Perſons together, then each of them in their ſeveral turns might ſucceſſively Labour in the cauſing of this Motion; which thereby would be much more conſtant and laſting, than it could otherwiſe be, if it did wholly depend on the Strength of the ſame Perſon. This Contrivance being as much to be preferred before any of the other, as ſwimming in a Ship before ſwimming in the Water.

CHAP. VIII.

A Reſolution of the two chief Difficulties that ſeem to oppoſe the Poſſibility of a flying Chariot.

THE chief Difficulties againſt the poſſibility of any ſuch Contrivance, may be fully removed in the Reſolution of theſe two *Quæries*.

1. Whether an Engine of ſuch Capacity and Weight, may be ſupported by ſo thin and light a Body as the Air?

2. Whether the Strength of the Perſons within it, may be ſufficient for the Motion of it?

Vitruvius Archit. l. 10. c. 22.

1. Concerning the firſt; when *Callias* was required by the Men of *Rhodes*, to take up that great *Helepolis*, brought againſt them by *Demetrius*, (as he had done before unto ſome leſs which he himſelf had made)

made) He anſwered that it could not be done. *Nonnulla enim ſunt quæ in exemplaribus videntur ſimilia, cum autem creſcere cæperunt, dilabuntur.* Becauſe thoſe Things that appear probable in leſſer Models, when they are increaſed to a greater Proportion, do thereby exceed the Power of Art. For Example, though a Man may make an Inſtrument to bore a Hole, an Inch wide, or half an Inch, and ſo leſs; yet to bore a Hole of a Foot wide, or two Foot, is not ſo much as to be thought of. Thus, though the Air may be able to uphold ſome leſſer Bodies, as thoſe of Birds, yet when the quantity of them is increaſed to any great Extenſion, it may juſtly be doubted, whether they will not exceed the Proportion that is naturally required unto ſuch kind of Bodies.

So *Ramus Schol. Mathem. l.* 1.

To this I anſwer, that the Engine can never be too big or too heavy, if the ſpace which it poſſeſſes in the Air, and the Motive-Faculty in the Inſtrument be anſwerable to its Weight. That Saying of *Callias* was but a groundleſs Shift and Evaſion, whereby he did endeavour to palliate his own Ignorance and Diſability. The utmoſt Truth which ſeems to be implied in it, is this: That there may be ſome Bodies of ſo great a Bigneſs, and Gravity, that it is very difficult to apply ſo much Force unto any particular Inſtrument, as ſhall be able to move them.

Againſt the Example it may be affirmed and eaſily proved, that it is equally poſſible to bore a Hole of any bigneſs, as well great as little, if we ſuppoſe the Inſtrument, and the Strength, and the Application of this Strength to be proportionable; But becauſe of the difficulty of theſe concurrent Circumſtances in thoſe greater and more unuſual Operations, therefore do they falſly ſeem to be abſolutely impoſſible.

So that the chief Inference from this Argument and Example, doth imply only thus much, that it is very difficult to contrive any ſuch motive Power, as ſhall be anſwerable to the Greatneſs and Weight of ſuch an Inſtrument as is here diſcourſed of; which doth not at all impair the Truth to be maintained: For if the poſſibility of ſuch a Motion be yielded, we need not make any ſcruple of granting the Difficulty of it; It is this muſt add a Glory to the Invention; and yet this will not perhaps ſeem ſo very difficult to any one who hath but diligently obſerved the Flight of ſome other Birds, particularly of a Kite, how he will ſwim up and down in the Air, ſometimes at a great height, and preſently again lower, guiding himſelf by his Train, with his Wings extended without any ſenſible Motion of them; and all this, when there is only ſome gentle breath of Air ſtirring, without the help of any ſtrong forcible Wind. Now I ſay, if that Fowl (which is none of the lighteſt) can ſo very eaſily move it ſelf up and down in the Air, without ſo much as ſtirring the Wings of it, certainly then it is not improbable, but that when all the due Proportions in ſuch an Engine are found out, and when Men by long Practice have arrived to any Skill and Experience, they will be able in this (as well as in many other Things) to come very near unto the imitation of Nature.

Gen. Nat. Qu. l. 1. c. 25.

As it is in thoſe Bodies which are carried on the Water, tho' they be never ſo big or ſo ponderous, (ſuppoſe equal to a City or a whole Iſland) yet they will always ſwim on the Top, if they be but any thing lighter than ſo much Water as is equal to them in Bigneſs: So likewiſe is it in the Bodies that are carried in the Air. It is not their Greatneſs (tho' never ſo immenſe) that can hinder their being ſupported in that light Element, if we ſuppoſe them to be extended unto a proportionable Space of Air.

And

And as from the former Experiments, *Archimedes* hath compoſed a ſubtle *Science* in his Book *De inſidentibus humido*, concerning the Weight of any heavy Body, in reference to the Water wherein it is; ſo from the particular Trial of theſe other Experiments, that are here enquired after, it is poſſible to raiſe a new Science, concerning the Extenſion of Bodies, in compariſon to the Air, and motive Faculties by which they are to be carried.

We ſee a great difference betwixt the ſeveral Quantities of ſuch Bodies as are commonly upheld by the Air; not only little Gnats, and Flies, but alſo the Eagle and other Fowl of vaſter Magnitude. *Cardan* and *Scaliger* do unanimouſly affirm, that there is a Bird amongſt the *Indians* of ſo great a Bigneſs, that his Beak is often uſed to make a Sheath or Scabbard for a Sword. And *Acoſta* tells us of a Fowl in *Peru* called *Candores*, which will of themſelves kill and eat up a whole Calf at a time. Nor is there any Reaſon why any other Body may not be ſupported and carried by the Air, though it ſhould as much exceed the Quantity of theſe Fowl, as they do the quantity of a Fly.

Subtil. l. 10. Exercit. 231.

Hiſtor. Nov. Orb. l. 4. c. 37.

Marcus Polus mentions a Fowl in *Madagaſcar*, which he calls a *Ruck*, the Feather of whoſe Wings are 12 Paces, or Threeſcore Foot long, which can with as much eaſe ſoop up an Elephant, as our Kites do a Mouſe. If this Relation were any thing credible, it might ſerve as an abundant Proof for the preſent *Quære*. But I conceive this to be already ſo evident, that it needs not any Fable for its further Confirmation.

2. The other doubt was, whether the Strength of the other Perſons within it, will be ſufficient for the moving of this Engine? I anſwer, the main Difficulty and Labour of it will be in the raiſing of it from the Ground; near unto which, the Earths attractive Vigor is of greateſt Efficacy. But for the better effecting of this, it may be

be helped by the Strength of Winds, and by taking its first Rise from some Mountain or other high Place. When once it is aloft in the Air, the Motion of it will be easie, as it is in the Flight of all kind of Birds, which being at any great Distance from the Earth, are able to continue their Motion for a long Time and Way, with little Labour or Weariness.

Plin. l. 10. *c.* 23.

'Tis certain from common Relation and Experience that many Birds do cross the Seas for divers hundred Miles together: Sundry of them amongst us, which are of a short Wing and Flight, as Blackbirds, Nightingales, *&c.* do flie from us into *Germany*, and other remoter Countries. And Mariners do commonly affirm that they have found some Fowl above six hundred Miles from any Land. Now if we should suppose these Birds to labour so much in those long Journies, as they do when they fly in our Sight and near the Earth, it were impossible for any of them to pass so far without resting. And therefore it is probable, that they do mount unto so high a Place in the Air, where the natural Heavinesse of their Bodies does prove but little or no impediment to their Flight: Tho' perhaps either Hunger, or the Sight of Ships, or the like accident, may sometimes occasion their descending lower; as we may guess of those Birds which Mariners have thus beheld, and divers others that have been drowned and cast up by the Sea.

Whence it may appear, that the Motion of this Chariot (tho' it may be difficult at the first) yet will still be easier as it ascends higher, till at length it shall become utterly devoid of Gravity, when the least Strength will be able to bestow upon it a swift Motion: As I have proved more at large in another Discourse.

World in the Moon, cap. 14.

But then, (may some object) If it be supposed that a Man in the Æthereal Air does lose his own Heavi-

Heavineſs, how ſhall he contribute any force towards the Motion of this Inſtrument?

I anſwer, The Strength of any living Creature in theſe external Motions, is ſomething really diſtinct from, and ſuperadded unto its natural Gravity: As common Experience may ſhew, not only in the Impreſſion of Blows or violent Motions, as a River Hawk will ſtrike a Fowl with a far greater Force, than the meer Deſcent or Heavineſs of his Body could poſſibly perform: But alſo in thoſe Actions which are done without ſuch Help, as the Pinching of the Finger, the Biting of the Teeth, *&c.* all which are of much greater Strength than can proceed from the meer Heavineſs of thoſe Parts.

As for the other particular Doubts, concerning the extream Thinneſs and Coldneſs of this Æthereal Air, by reaſon of which, it may ſeem to be altogether impaſſible, I have already reſolved them in the above-cited Diſcourſe.

The Uſes of ſuch a Chariot may be various: Beſides the Diſcoveries which might be thereby made in the Lunary World, it would be ſerviceable alſo for the Conveyance of a Man to any remote Place of this Earth: As ſuppoſe to the *Indies* or *Antipodes*. For when once it was elevated for ſome few Miles, ſo as to be above that Orb of Magnetick Virtue, which is carried about by the Earth's diurnal Revolution, it might then be very eaſily and ſpeedily directed to any particular Place of this great Globe.

If the Place which we intended were under the ſame Parallel, why then the Earth's Revolution once in Twenty four Hours, would bring it to be under us; ſo that it would be but deſcending in a ſtraight Line, and we might preſently be there. If it were under any other Parallel, it would then only require that we ſhould direct it in the ſame Meridian,

till

tilll we did come to that Parallel; and then (as before) a Man might eaſily deſcend unto it.

It would be one great Advantage in this kind of Travelling, that one ſhould be perfectly freed from all Inconveniences of Ways or Weather, not having any Extremity of Heat or Cold, or Tempeſts to moleſt him. This Æthereal Air being perpetually in an equal Temper and Calmneſs. *Pars ſuperior mundi ordinatior eſt nec in nubem cogitur, nec in tempeſtatem impellitur, nec verſatur in turbinem, omni tumultu caret, inferiora fulminant.* The upper Parts of the World are always quiet and ſerene, no Winds and Bluſtring there, they are theſe lower cloudy Regions that are ſo full of Tempeſts and Combuſtion.

Sen de Ira. l. 3. c. 6. Pacem ſumma tenent. Lucan.

As for the Manner how the Force of a Spring, or (inſtead of that) the Strength of any living Perſon, may be applied to the Motion of theſe Wings of the Chariot, it may eaſily be apprehended from what was formerly delivered.

There are divers other particulars to be more fully enquired after, for the perfecting of ſuch a flying Chariot; as concerning the Proportion of the Wings both for the Length and Breadth, in compariſon to the Weight which is to be carried by them; as alſo concerning thoſe ſpecial Contrivances, whereby the Strength of theſe Wings may be ſeverally applied, either to aſcent, deſcent, progreſſive, or a turning Motion; all which, and divers the like Enquiries can only be reſolved by particular Experiments. We know the Invention of Sailing in Ships does continually receive ſome new Addition from the Experience of every Age, and hath been a long while growing up to that Perfection unto which it is now arrived. And ſo muſt it be expected for this likewiſe, which may at firſt perhaps ſeem perplexed with many Difficulties and Inconveniences, and yet upon the Experience of frequent Trials, many things may

As well too long as too ſhort, too broad as too narrow, may be an impediment to the motion, by making it more difficult, ſlow and flagging.

may be ſuggeſted to make it more facil and commodious.

He that would regularly attempt any Thing to this Purpoſe, ſhould obſerve this Progreſs in his Experiments; he ſhould firſt make Enquiry what kind of Wings would be moſt uſeful to this End; thoſe of a Bat being moſt eaſily imitable, and perhaps Nature did by them purpoſely intend ſome Intimation to direct us in ſuch Experiments; that Creature being not properly a Bird, becauſe not amongſt the *Ovipara*, to imply that other kind of Creatures are capable of Flying as well as Birds; and if any ſhould attempt it, that would be the beſt Pattern for Imitation.

After this he may try what may be effected by the Force of Springs in leſſer Models, anſwerable unto *Archytas* his Dove, and *Regiomontanus* his Eagle: In which he muſt be careful to obſerve the various Proportions betwixt the Strength of the Spring, the Heavineſs of the Body, the Breadth of the Wings, the Swiftneſs of the Motion, *&c.*

From theſe he may by Degrees aſcend to ſome larger Eſſays.

CHAP. IX.

Of a perpetual Motion. The ſeeming Facility and real Difficulty of any ſuch Contrivance. The ſeveral Ways whereby it hath been attempted, particularly by Chymiſtry.

IT is the chief Inconvenience of all the *Automata* before-mentioned, that they need a frequent Repair of new Strength, the Cauſes whence their Motion does proceed, being ſubject to fail, and come to

to a Period; and therefore it would be worth our Enquiry, to examine whether or no there may be made any such artificial Contrivance, which might have the Principle of moving from it self; so that the present Motion should constantly be the cause of that which succeeds.

This is that great Secret in *Art*, which, like the Philosopher's Stone in *Nature*, hath been the Business and Study of many more refined Wits, for divers Ages together; and it may well be questioned, whether either of them as yet hath ever been found out; though if this have, yet, like the other, it is not plainly treated of by any Author.

Not but that there are sundry Discourses concerning this Subject, but they are rather *Conjectures* than *Experiments*. And though many Inventions in this kind, may at first view bear a great shew of probability, yet they will fail, being brought to Trial, and will not answer in Practice what they promised in Speculation. Any one who hath been versed in these Experiments must needs acknowledge that he hath been often deceived in his strongest Confidence; when the Imagination hath contrived the whole Frame of such an Instrument, and conceives that the Event must infallibly answer its hopes, yet then does it strangely deceive in the Proof, and discovers to us some Defect which we did not before take Notice of.

Hence it is, that you shall scarce talk with any one who hath never so little smattering in these Arts, but he will instantly promise such a Motion, as being but an easy Atchievement, till further Trial and Experience hath taught him the Difficulty of it. There being no Enquiry that does more entice with the *Probability*, and deceive with the *Subtilty*. What one speaks wittily concerning the Philosopher's Stone, may be justly applied to this, that it is *Casta Meretrix*, a chast Whore. *Quia multos invitat, neminem*

nem admittit, becauſe it allures many, but admits none.

I ſhall briefly recite the ſeveral ways whereby this hath been attempted, or ſeems moſt likely to be effected; thereby to contract and facilitate the Enquiries of thoſe who are addicted to theſe kind of Experiments; for when they know the defects of other Inventions, they may the more eaſily avoid the ſame or the like in their own.

The ways whereby this hath been attempted, may be generally reduced to theſe three Kinds:

1. By Chymical Extractions.
2. By Magnetical Virtues.
3. By the natural Affection of Gravity.

1. The diſcovery of this hath been attempted by Chymiſtry. *Paracelſus* and his Followers have bragged, that by their Separations and Extractions, they can make a little World which ſhall have the ſame perpetual Motions with this *Microcoſm*, with the Repreſentation of all Meteors, Thunder, Snow, Rain, the Courſes of the Sea in its Ebbs and Flows, and the like; But theſe miraculous Promiſes would require as great a Faith to believe them, as a Power to perform them: And tho' they often talk of ſuch great Matters,

At nuſquam totos inter qui talia curant,
Apparet ullus, qui re miracula tanta
Comprobet ——

yet we can never ſee them confirmed by any real Experiment; and then beſides, every particular Author in that Art hath ſuch a diſtinct Language of his own, (all of them being ſo full of Allegories and affected Obſcurities) that 'tis very hard for any one (unleſs he be throughly verſed amongſt them) to find out what they mean, much more to try it.

One of theſe ways (as I find it ſet down) is this. Mix five Ounces of ☿, with an equal Weight of ♃, grind them together with ten Ounces of Sublimate, diſſolve them in a Cellar upon ſome Marble for the ſpace *Etten. Mathem. Recreat. prob.* 118.

ſpace of four Days, till they become like Oil Olive; diſtil this with Fire of Chaff, or driving Fire, and it will ſublime into a dry Subſtance: And ſo by repeating of theſe Diſſolvings and Diſtillings, there will be at length produced divers ſmall Attoms, which being put into a Glaſs well luted, and kept dry, will have a perpetual Motion.

I cannot ſay any thing from Experience againſt this; but methinks it does not ſeem very probable, becauſe Things that are forced up to ſuch a Vigorouſneſs and Activity as theſe Ingredients ſeem to be by their frequent Sublimatings and Diſtillings, are not likely to be of any Duration; the more any thing is ſtretched beyond its uſual Nature, the leſs does it laſt; Violence and Perpetuity being no Companions. And then beſides, ſuppoſe it true, yet ſuch a Motion could not well be applied to any Uſe, which muſt needs take much from the Delight of it.

Celebrated in an Epigram by *Hugo Grotius*, *l.* 1. *Epiſt. ad Erneſtum de Lamp. Vitæ.*

Amongſt the Chymical Experiments to this purpoſe, may be reckoned up that famous Motion invented by *Cornelius Dreble*, and made for King *James*; wherein was repreſented the conſtant Revolutions of the Sun and Moon, and that without the help either of Springs or Weights. *Marcellus Vranckhein*, ſpeaking of the Means whereby it was performed, he calls it, *Scintillula animæ magneticæ mundi, ſeu Aſtralis & inſenſibilis ſpiritus*; being that grand Secret, for the diſcovery of which, thoſe Dictators of Phyloſophy, *Democritus*, *Pythagoras*, *Plato*, did Travel unto the *Gymnoſophiſts*, and *Indian* Prieſts. The Author himſelf in his Diſcourſe upon it, does not at all reveal the way how it was performed. But there is one *Thomas Tymme*, who was a familiar Acquaintance of his, and did often pry into his Works, (as he profeſſes himſelf) who affirms it to be done thus; *By extracting a fiery Spirit out of the Mineral Matter, joining the ſame with his proper Air, which in-*

Epiſt. ad Jacobum Regem.

cluded

cluded in the Axle Tree (of the firſt moving Wheel) *being hollow, carrieth the other Wheels, making a continual Rotation, except iſſue or vent be given in this hollow Axle Tree, whereby the impriſoned Spirit may get forth.*

Philoſophical Dialogue. *Confer.* 2. *cap.* 3.

What ſtrange Things may be done by ſuch Extractions, I know not, and therefore dare not condemn this Relation as impoſſible; but methinks it ſounds rather like a Chymical Dream, than a Philoſophical Truth. It ſeems this impriſoned Spirit is now ſet at Liberty, or elſe is grown weary, for the Inſtrument (as I have heard) hath ſtood ſtill for many Years. It is here conſiderable that any Force is weakeſt near the Center of a Wheel; and therefore though ſuch a Spirit might of it ſelf have an Agitation, yet 'tis not eaſily conceivable how it ſhould have Strength enough to carry the Wheels about with it. And then the Abſurdity of the Author's citing this, would make one miſtruſt his Miſtake; he urges it as a ſtrong Argument againſt *Copernicus*, as if becauſe *Dreble* did thus contrive in an Engine the Revolution of the Heavens, and the Immoveableneſs of the Earth, therefore it muſt needs follow that 'tis the Heavens which are moved, and not the Earth. If his Relation were no truer than his Conſequence, it had not been worth the Citing.

CHAP. X.

Of Subterraneous Lamps; divers Hiſtorical Relations concerning their Duration for many Hundred Years together.

UNto this kind of Chymical Experiments, we may moſt probably reduce thoſe perpetual Lamps, which for many Hundred Years together have

have continued burning without any new fupply in the Sepulchres of the Ancients, and might (for ought we know) have remained ſo for ever. All Fire, and eſpecially Flame, being of an active and ſtirring Nature, it cannot therefore ſubſiſt without Motion; whence it may ſeem, that this great Enquiry hath been this way accompliſhed: And therefore it will be worth our Examination to ſearch further into the Particulars that concern this Experiment. Though it be not ſo proper to the chief purpoſe of this Diſcourſe, which concerns *Mechanical Geometry*, yet the Subtilty and Curioſity of it may abundantly requite the Impertinency.

There are ſundry Authors, who Treat of this Subject on the by, and in ſome particular Paſſages, but none that I know of (except *Fortunius Licetus*) that hath writ purpoſely any ſet and large Diſcourſe concerning it: Out of whom I ſhall borrow many of thoſe Relations and Opinions, which may moſt naturally conduce to the preſent Enquiry.

Lib. de reconditis antiquorum lucernis.

For our fuller underſtanding of this, there are theſe Particulars to be explained:

1. ὅτι, or *quod ſit.*
2. διότι { *cur ſit.* / *quomodo ſit.*

1. Firſt then, for the ὅτι, or that there have been ſuch Lamps, it may be evident from ſundry plain and undeniable Teſtimonies: St. *Auſtin* mentions one of them in a Temple dedicated to *Venus*, which was always expoſed to the open Weather, and could never be conſumed or extinguiſhed. To him aſſents the judicious *Zanchy*. *Pancyrollus* mentions a Lamp found in his Time, in the Sepulchre of *Tullia*, *Cicero*'s Daughter, which had continued there for about 1550 Years, but was preſently extinguiſhed upon the admiſſion of new Air. And 'tis commonly related

De civitat. Dei l. 21. *c.* 6.

De operibus Dei, pars 1. *l.* 4. *c.* 12.

De deperd. Tit. 35.

of

of *Cedrenus*, that in *Juſtinian*'s Time there was another burning Lamp found in an old Wall at * *Edeſſa*, which had remained ſo for above 500 Years, there being a Crucifix placed by it, whence it ſhould ſeem, that they were in Uſe alſo amongſt ſome Chriſtians.

* Or *Antioch. Licetus de Lucernis, l.1.c.7.*

But more eſpecially remarkable, is that Relation celebrated by ſo many Authors, concerning *Olybius* his Lamp, which had continued burning for 1500 Years. The Story is thus: As a Ruſtick was digging the Ground by *Padua*, he found an Urn or Earthen Pot, in which there was another Urn, and in this leſſer, a Lamp clearly burning; on each ſide of it there were two other Veſſels, each of them full of a pure Liquor; the one of Gold, the other of Silver. *Ego Chymiæ artis, (ſimodo vera poteſt eſſe ars Chymia) jurare auſim elementa & materiam omnium,* (ſaith *Maturantius*, who had the Poſſeſſion of theſe things after they were taken up.) On the bigger of theſe Urns there was this Inſcription:

Plutoni ſacrum munus ne attingite fures.
Ignotum eſt vobis hoc quod in orbe latet,
Namque elementa gravi clauſit digeſta labore
Vaſe ſub hoc modico, Maximus Olybius.
Adſit fœcundo cuſtos ſibi copia cornu,
Ne tanti pretium depereat laticis.

The leſſer Urn was thus inſcribed.

Abite hinc peſſimi fures,
Vos quid vultis, veſtris cum oculis emiſſitiis?
Abite hinc, veſtro cum Mercurio
Petaſato Caduceatoque,
Domum hoc Maximum, Maximus Olybius
Plutoni ſacrum facit.

Whence we may probably conjecture that it was ſome Chymical Secret, by which this was contrived.

Mag. Natural. l. 12. cap. ult.

Baptista Porta tells us of another Lamp burning in an old marble Sepulchre, belonging to some of the Ancient *Romans*, inclosed in a Glass Vial, found in his Time, about the Year 1550, in the Isle *Nesis*, which had been buried there before our Saviour's coming.

Chron. Martin. Fort. Licet. de lucern. l. 1. c. 11.

In the Tomb of *Pallas*, the *Archadian* who was slain by *Turnus* in the *Trojan* War, there was found another burning Lamp, in the Year of our Lord 1401. Whence it should seem, that it had continued there for above Two thousand and Six hundred Years: And being taken out, it did remain burning, notwithstanding either Wind or Water, with which some did strive to quench it; nor could it be extinguished till they had spilt the Liquor that was in it.

Not. ad August. de civit. Dei, l. 21. c. 6.

Ludovicus Vives tells us of another Lamp, that did continue burning for 1050 Years, which was found a little before his Time.

Such a Lamp is likewise related to be seen in the Sepulchre of *Francis Rosicrosse*, as is more largely expressed in the Confession of that Fraternity.

There is another Relation of a certain Man, who upon occasion digging somewhat deep in the Ground did meet with something like a Door, having a Wall on each Hand of it; from which having cleared the Earth, he forced open this Door, upon this there was discovered a fair Vault, and towards the further Side of it, the Statue of a Man in Armour, sitting by a Table, leaning upon his Left Arm, and holding a Scepter in his Right Hand, with a Lamp burning before him; the Floor of this Vault being so contrived, that upon the first Step into it, the Statue would erect it self from its leaning Posture; upon the second Step it did lift up the Scepter to strike, and before a Man could approach near enough to take hold of the Lamp, the Statue did strike and break it to Pieces: Such Care was there taken that

it

it might not be ſtoln away, or diſcovered.

Our Learned *Cambden* in his Deſcription of *Yorkſhire*, ſpeaking of the Tomb of *Conſtantius Chlorus*, broken up in theſe later Years, mentions ſuch a Lamp to be found within it. *Pag.* 572.

There are ſundry other Relations to this Purpoſe. *Quod ad lucernas attinet, illæ in omnibus fere monumentis inveniuntur*, (ſaith *Gutherius.*) In moſt of the Ancient Monuments there is ſome kind of Lamp, (tho' of the ordinary Sort:) But thoſe Perſons who were of greateſt Note and Wiſdom, did procure ſuch as might laſt without Supply, for ſo many Ages together. *Pancirollus* tells us, that it was uſual for the Nobles amongſt the *Romans*, to take ſpecial Care in their laſt Wills, that they might have a Lamp in their Monuments. And to this Purpoſe they did uſually give Liberty unto ſome of their Slaves on this Condition, that they ſhould be watchful in maintaining and preſerving it. From all which Relations, the firſt particular of this Enquiry, concerning the Being or Exiſtence of ſuch Lamps, may ſufficiently appear. *De jure manium, l.* 2. *c.* 32. *De perdit. Tit.* 62.

CHAP. XI.

Several Opinions concerning the Nature and Reaſon of theſe perpetual Lamps.

THere are two Opinions to be anſwered, which do utterly overthrow the chief Conſequence from theſe Relations.

1. Some think that theſe Lights ſo often diſcovered in the Ancient Tombs, were not Fire or Flame, but only ſome of thoſe bright Bodies which do uſually ſhine in dark Places.

2. Others grant them to be Fire, but yet think them

them to be then firſt enkindled by the Admiſſion of new Air, when theſe Sepulchres were opened.

1. There are divers Bodies (ſaith *Ariſtotle*) which ſhine in the Dark, as rotten Wood, the Scales of ſome Fiſhes, Stones, the Gloworm, the Eyes of divers Creatures. *Cardan* tells us of a Bird in new *Spain*, called *Cocoyum*, whoſe whole Body is very bright, but his Eyes almoſt equal to the Light of a Candle, by which alone in a dark Night, one may both write and read: By theſe the *Indians* (ſaith he) uſe to eat their feaſting Suppers.

De anima, l. 2. c. 7.

Subtil. l. 9.

It is commonly related and believed, that a Carbuncle does ſhine in the Dark like a burning Coal, from whence it hath its * Name. To which Purpoſe there is a Story in *Ælian* of a Stork, that by a certain Woman was cured of a broken Thigh, in Gratitude to whom, this Fowl afterwards flying by her, did let fall into her Lap a bright Carbuncle, which (ſaith he) would in the Night Time ſhine as clear as a Lamp. But this and the like old Relations are now generally disbelieved and rejected by learned Men: *Doctiſſimorum omnium conſenſu, hujuſmodi gemmæ non inveniuntur*, (ſaith *Boetius de Boot*) a Man very much skilled in, and inquiſitive after ſuch Matters; nor is there any one of Name that does from his own Eye-ſight or Experience, affirm the real Exiſtence of any Gem ſo qualified.

* *Carlo Pyropus. Hiſtoria Anim. l. 8.*

De Lapid. & Gemmis. l. 2. c. 8.

Some have thought that the Light in Ancient Tombs hath been occaſioned from ſome ſuch Bodies as theſe. For if there had been any Poſſibility to preſerve Fire ſo long a Space, 'tis likely then that the *Iſraelites* would have known the Way, who were to keep it perpetually for their Sacrifices.

Vide Liceet. de lucern. l. 2.

But to this Opinion it might be replied, that none of theſe *Noctilucæ*, or Night-ſhining Bodies have been obſerved in any of the Ancient Sepulchres, and therefore this is a mere imaginaty Conjecture; and then

then beſides, ſome of theſe Lamps have been taken out burning, and continued ſo for a conſiderable Space afterwards. As for the ſuppoſed Conveniency of them, for the perpetuating of the Holy Fire amongſt the *Jews*, it may as well be feared leſt theſe ſhould have occaſioned their Idolatry, unto which that Nation was ſo ſtrongly addicted, upon every ſlight Occaſion; nor may it ſeem ſtrange, if the Providence of God ſhould rather permit this Fire ſometimes to go out, that ſo by their earneſt Prayers, being again renewed from Heaven, (as it * ſometimes was) the Peoples Faith might be the better ſtirred up and ſtrengthned by ſuch frequent Miracles.

* Levit. 9. 24. 2 Chron. 7. 1. 1 King. 18. 38.

2. It is the Opinion of *Gutherius*, that theſe Lamps have not continued burning for ſo long a Space, as they are ſuppoſed in the former Relations; but that they were then firſt enflamed by the Admiſſion of new Air, or ſuch other occaſion, when the Sepulchres were opened: As we ſee in thoſe fat Earthy Vapours of divers Sorts, which are oftentimes enkindled into a Flame. And 'tis ſaid, that there are ſome Chymical Ways, whereby Iron may be ſo heated, that being cloſely luted in a Glaſs, it ſhall conſtantly retain the Fire for any Space of Time, though it were for a thouſand Years or more; at the end of which, if the Glaſs be opened, and the freſh Air admitted, the Iron ſhall be as red Hot as if it were newly taken out of the Fire. *De jure Mani. l. 2 c. 32.*

But for anſwer to this Opinion, 'tis conſiderable that ſome Urns have had Inſcriptions on them, expreſſing that the Lamps within them were burning, when they were firſt buried. To which may be added the Experience of thoſe which have continued ſo, for a good Space afterwards; whereas the Inflammation of fat and viſcous Vapours does preſently vaniſh. The Lamp which was found in the Iſle *Neſis*, did burn clearly while it was incloſed in

the Glaſs, but that being broken, was prefently extinguiſhed. As for that Chymical Relation, it may rather ſerve to prove that Fire may continue ſo many Ages, without conſuming any Fewel.

So that notwithſtanding the oppoſite Opinions, yet 'tis more probable that there have been ſuch Lamps as have *remained burning*, without any new Supply, for many hundred Years together; which was the firſt Particular to be explained.

Cur ſint. 2. Concerning the Reaſon why the Ancients were ſo careful in this Particular, there are divers Opinions. Some think it to be an Expreſſion of their Belief, concerning the Soul's Immortality, after its departure out of the Body; a Lamp amongſt the *Egyptians* being the *Hieroglyphick* of Life. And therefore they that could not procure ſuch Lamps, were yet careful to have the Image and Repreſentation of them engraved on their Tombs.

Others conceive them to be by way of Gratitude to thoſe infernal Deities, who took the Charge and Cuſtody of their dead Bodies *remaining* always with them in their Tombs, and were therefore called *Dii manes*.

Others are of Opinion, that theſe Lamps were only intended to make their Sepulchres more pleaſant and lightſome, that they might not ſeem to be impriſoned in a diſmal and uncomfortable Place. True indeed, the dead Body cannot be ſenſible of this Light, no more could it of its want of Burial; yet the ſame Inſtinct which did excite it to the Deſire of one, did alſo occaſion the other.

De Lucernis, l. 3. c. 8. *Licetus* concludes this Ancient Cuſtom to have a double End. 1. *Politick*, for the Diſtinction of ſuch as were nobly born, in whoſe Monuments only they were uſed. 2. *Natural*, to preſerve the Body and Soul from Darkneſs; for it was a common Opinion amongſt them, that the Souls alſo were much converſant about thoſe Places where the Bodies were buried.

CHAP.

CHAP. XII.

The most probable Conjecture, how these Lamps were framed.

Quomodo sint.

THE greatest difficulty of this Enquiry doth consist in this last Particular, concerning the manner how, or by what possible Means any such perpetual Flame may be contrived.

For the discovery of which, there are two things to be more especially considered.

1. The Snuff, or Wick, which must administer unto the Flame.

2. The Oil, which must nourish it.

For the *first*, it is generally granted that there are divers Substances which will retain Fire without consuming: Such is that Mineral which they call the *Salamanders Wooll*, saith our Learned * *Bacon*. *Ipse expertus sum villos Salamandræ non consumi*, saith † *Joachimus Fortius*. And * *Wecker*, from his own knowledge, affirms the same of *Plumeallum*, that being formed into the likeness of a Wick, will administer to the Flame, and yet not consume it self. Of this Nature likewise was that which the Ancients did call *Linum Vivum*, or *Asbestinum*: Of this they were wont to make Garments, that were not destroyed, but purified by Fire; and whereas the Spots or Foulness of other Cloaths are washed out, in these they were usually burnt away. The Bodies of the ancient Kings were wrapped in such Garments, when they were put in the Funeral Pile, that their Ashes might be therein preserved, without the mixture of any other. The Materials of them were not from any Herb or Vegetable, as other Textiles, but from a Stone called *Amiantus*; which being bruised by a Hammer,

* *Nat. Hist. Exper.* 774.

† *Lib. Exper.*

* *De Secretis, l.* 3. *c.* 2.

Or *Linum Carpasium*. *Plutarch, de Oracul. defectu.*

Plin. Hist. l. 19. *c.* 1.

Hammer, and its earthly Nature ſhaken out, retains certain hairy Subſtances, which may be Spun and Woven, as Hemp or Flax. *Pliny* ſays, that for the Preciouſneſs of it, it did almoſt equal the Price of Pearls. *Pancirollus* tells us, that it was very rare, and eſteemed precious in ancient Times, but now is ſcarce found or known in any Places, and therefore he reckons it amongſt the things that are loſt. But *L. Vives* affirms, that he hath often ſeen Wicks made of it at *Paris*, and the ſame Matter woven into a Napkin at *Lovaine*, which was cleanſed by being burnt in the Fire.

De perd. Tit. 4.

In Auguſt. de Civit. Dei, l. 21. c. 6.

'Tis probable from theſe various Relations, that there was ſeveral Sorts of it; ſome of a more precious, other of a baſer kind, that was found in *Cyprus*, the Deſerts of *India*, and a certain Province of *Aſia*; this being common in ſome Parts of *Italy*, but is ſo ſhort and brittle, that it cannot be ſpun into a Thread; and therefore is uſeful only for the Wicks of perpetual Lamps, ſaith *Boetius de Boot.* Some of this, or very like it, I have upon Enquiry lately procured and experimented; but whether it be the Stone *Asbeſtus*, or only *Plumeallum*, I cannot certainly affirm; for it ſeems they are both ſo very like, as to be commonly Sold for one another (ſaith the ſame Author.) However, it does truly agree in this common Quality aſcribed unto both, of being Incombuſtible, and not conſumable by Fire: But yet there is this Inconvenience, That it doth contract ſo much Fuliginous Matter from the Earthly Parts of the Oil, (though it was tryed with ſome of the pureſt Oil which is ordinary to be bought) that in a very few Days it did choak and extinguiſh the Flame. There may poſſibly be ſome Chymical way, ſo to purifie and defecate this Oil, that it ſhall not ſpend into a ſootty Matter.

De lapid. & gemmis, l. 2. c. 204.

However, if the Liquor be of a cloſe and Glutinous Conſiſtency, it may burn without any Snuff, as

as we ſee in Camphire, and ſome other Bituminous Subſtances. And it is probable that moſt of the ancient Lamps were of this kind, becauſe the exacteſt Relations (to my Remembrance) do not mention any that have been found with ſuch Wicks.

But herein will conſiſt the greateſt Difficulty, to find out what Invention there might be for their Duration: Concerning which there are ſundry Opinions.

St. *Auſtin* ſpeaking of that Lamp in one of the Heathen Temples, thinks that it might either be done by Magick, (the Devil thinking thereby to promote the Worſhip and Eſteem of that Idol to which it was Dedicated) or elſe, that the Art of Man might make it of ſome ſuch Material, as the Stone *Asbeſtus*, which being once kindled, will burn without being conſumed. As others (ſaith he) have contrived as great a Wonder in appearance, from the natural Virtue of another Stone, making an Iron Image ſeem to hang in the Air, by reaſon of two Load-Stones, the one being placed in the Ceiling, the other in the Floor. *Deciv. Dei, l. 21. c. 6.* *Zanch. de Operibus Dei, par. 1. l. 4. c. 12.*

Others are of Opinion, that this may be effected in a hollow Veſſel, exactly luted or ſtopped up in all the Vents of it: And then, if a Lamp be ſuppoſed to burn in it but for the leaſt moment of time, it muſt continue ſo always, or elſe there would be a *Vacuum*, which Nature is not capable of. If you ask how it ſhall be nouriſhed, it is anſwered, That the Oil of it being turned into Smoak and Vapours, will again be converted into its former Nature; for otherwiſe, if it ſhould remain Rarified in ſo thin a Subſtance, then there would not be room enough for that Fume which muſt ſucceed it; and ſo on the other ſide, there might be ſome danger of the *Penetration* of Bodies, which Nature doth as much abhor. To prevent both which, as it is in the Chymical Circulations, where the ſame Body is often-

times

times turned from Liquor into Vapour, and from Vapour into Liquor again; ſo in this Experiment, the ſame Oil ſhall be turned into Fume, and that Fume ſhall again convert into Oil. Always provided, that this Oil which nouriſhes the Lamp, be ſuppoſed of ſo cloſe and tenacious a Subſtance, that may ſlowly evaporate, and ſo there will be the more Leiſure for Nature to perfect theſe Circulations. According to which Contrivance, the Lamp within this Veſſel can never fail, being always ſupplied with ſufficient Nouriſhment. That which was found in the Iſle *Neſis*, incloſed in a Glaſs-Vial, mentioned by *Baptiſta Porta*, is thought to be made after ſome ſuch manner as this.

Wolphang. Lazius, l 3. *c.* 18. *Camb. Brit. p.* 572.

Others conceive it poſſible to extract ſuch an Oil out of ſome Minerals, which ſhall for a long ſpace ſerve to nouriſh the Flame of a Lamp, with very little or no Expence of its own Subſtance. To which purpoſe (ſay they) if Gold be diſſolved into an unctuous Humour, or if the radical Moiſture of that Metal were ſeparated, it might be contrived to burn (perhaps for ever, or at leaſt) for many Ages together, without being conſumed. For, if Gold it ſelf (as Experience ſhews) be ſo untameable by the Fire, that after many Meltings and violent Heats, it does ſcarce diminiſh, 'tis probable then, that being diſſolved into an Oily Subſtance, it might for many hundred Years together continue burning.

There is a little Chymical Diſcourſe, to prove that *Urim* and *Thummim* is to be made by Art. The Author of this Treatiſe affirms that place, *Gen.* 6. 16. where God tells *Noah*, *A Window ſhalt thou make in the Ark*, to be very unfitly rendred in our Tranſlation, a *Window*; becauſe the original Word צהר ſignifies properly Splendor, or Light: And then beſides, the Air being at that timec ſo extreamly darkned with the Clouds of that exeſſive Rain, a Window could be but of very little uſe in regard of

Light,

Light, unleſs there were ſome other help for it. From whence he conjectures, that both this Splendor, and ſo likewiſe the *Urim* and *Thummim* were artificial Chymical Preparations of Light, anſwerable to theſe ſubterraneous Lamps; or in his own Phraſe, it was *the univerſal Spirit fixed in a tranſparent Body.*

It is the Opinion of *Licetus*, (who hath more exactly ſearched into the Subtilties of this Enquiry) that Fire does not need any Humour for the Nouriſhment of it, but only to detain it from flying upwards: For, being in it ſelf one of the chief Elements (ſaith he out of *Theophraſtus*) it were abſurd to think that it could not ſubſiſt without ſomething to feed it. As for that Subſtance which is conſumed by it, this cannot be ſaid to foment or preſerve the ſame Fire, but only to generate new. For the better underſtanding of this, we muſt obſerve, that there may be a threefold proportion betwixt Fire, and the Humour, or Matter of it. Either the Humour does exceed the ſtrength of the Fire, or the Fire does exceed the Humour; and according to both theſe, the Flame doth preſently vaniſh. Or elſe laſtly, they may be both equal in their Virtues, (as it is betwixt the Radical Moiſture, and Natural Heat in Living Creatures) and then neither of them can overcome, or deſtroy the other. *De Lucernis, c. 20, 21.*

Thoſe ancient Lamps of ſuch long Duration, were of this later kind: But now, becauſe the Qualities of Heat or Cold, Dryneſs or Moiſture in the ambient Air, may alter this Equality of Proportion betwixt them, and make one ſtronger than the other; therefore to prevent this, the Ancients did hide theſe Lamps in ſome Caverns of the Earth, or cloſe Monuments. And hence is it, that at the opening of theſe, the admiſſion of new Air unto the Lamp does uſually cauſe ſo great an Inequality betwixt the Flame and the Oil, that it is preſently extinguiſhed.

But

But ſtill, the greateſt Difficulty remains how to make any ſuch exact Proportion betwixt an unctuous Humour, and ſuch an active Quality as the heat of Fire; or this Equality being made, it is yet a further Difficulty, how it may be preſerved. To which purpoſe, *Licetus* thinks it poſſible to extract an inflamable Oil from the Stone *Asbeſtus*, *Amiantus*, or the Metal Gold; which being of the ſame pure and homogeneous Nature with thoſe Bodies, ſhall be ſo proportioned unto the heat of Fire, that it cannot be conſumed by it; but being once inflamed, ſhould continue for many Ages, without any ſenſible Diminution.

If it be in the power of Chymiſtry to perform ſuch ſtrange Effects, as are commonly experimented in that which they call *Aurum Fulminans*, one Scruple of which ſhall give a louder Blow, and be of greater force in Deſcent, than half a Pound of ordinary Gunpowder in Aſcent; why may it not be as feaſible by the ſame Art, to extract ſuch an Oil as is here enquired after? ſince it muſt needs be more difficult to make a Fire, (which of its own Inclination ſhall tend downwards) than to contrive ſuch an unctuous Liquor, wherein Fire ſhall be maintained for many Years without any new ſupply.

Thus have I briefly ſet down the Relations and Opinions of divers Learned Men, concerning theſe perpetual Lamps; of which, though there have been ſo many ſundry kinds, and ſeveral ways to make them, (ſome being able to reſiſt any Violence of Weathers, others being eaſily extinguiſhed by any little alteration of the Air, ſome being incloſed round about within Glaſs, others being open;) yet now they are all of them utterly periſhed amongſt the other Ruins of Time; and thoſe who are moſt verſed in the ſearch after them, have only recovered ſuch dark Conjectures, from which a Man cannot clearly deduce any evident Principle, that may encourage him to a particular Trial.

CHAP.

CHAP. XIII.

Concerning several Attempts of Contriving a perpetual Motion, by Magnetical Virtues.

THE second way whereby the making of a perpetual Motion hath been attempted, is by Magnetical Virtues; which are not without some strong Probabilities of proving effectual to this purpose: Especially when we consider, that the Heavenly Revolutions, (being as the first Pattern imitated and aimed at in these Attempts) are all of them performed by the help of these Qualities. This great Orb of Earth, and all the other Planets, being but as so many Magnetical Globes, endowed with such various ahd continual Motions, as may be most agreeable to the Purposes for which they were intended. And therefore most of the Authors, who treat concerning this Invention, do agree, that the likeliest way to effect it, is by these kind of Qualities.

It was the Opinion of *Pet. Peregrinus*, and there is an Example pretended for it in *Bettinus*, (*Apiar.* 9. *Progym.* 5. *pro.* 11.) that a Magnetical Globe, or Terella, being rightly placed upon its Poles, would of it self have a constant Rotation, like the Diurnal Motion of the Earth: But this is commonly exploded, as being against all Experience.

Others think it possible, so to contrive several Pieces of Steel and a Load-Stone, that by their continual Attraction, and Expulsion of one another, they may cause a perpetual Revolution of a Wheel. Of this Opinion were [a] *Taisner*, [b] *Pet. Peregrinus*, and [c] *Cardan*, out of *Antonius de Fantis*. But D. *Gilbert*, who was more especially versed in Magnetical Experiments, concludes it to be a vain and groundless Fancy. But

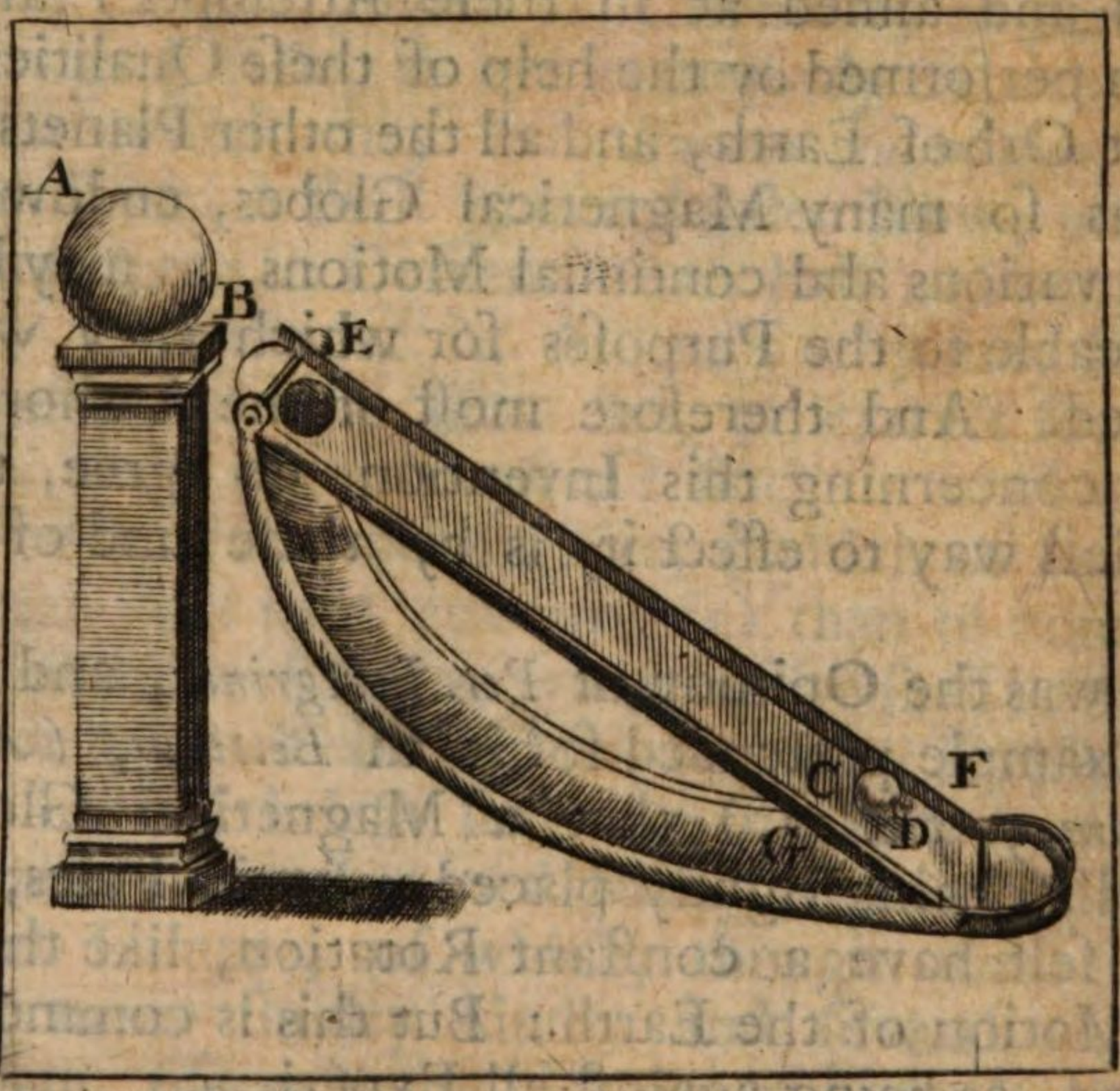
Gilbert de Magnet. Cabæus Philos. Magnet. l. 4. c. 20. Athanas. Kircher, de Arte Magnet. l. 1. par. 2, prop. 13. Item l. 2. p. 4.

[a] *Tract. de motu continuo.*

[b] *De Rota perpetui motus. par. 2. c. 3.*

[c] *De Variet. rerum, l. 9. c. 48. De Magnet. l. 2. c. 35.*

But amongſt all theſe kind of Inventions, that is moſt likely, wherein a Load-Stone is ſo diſpoſed, that it ſhall draw unto it on a reclined Plane, a Bullet of Steel, which Steel as it aſcends near to the Load-ſtone, may be contrived to fall down thro' ſome Hole in the Plane, and ſo to return unto the Place from whence at firſt it began to move; and being there, the Loadſtone will again attract it upwards, till coming to this Hole, it will fall down again; and ſo the Motion ſhall be perpetual, as may be more eaſily conceivable by this Figure.



Suppoſe the Load-Stone to be repreſented at *A B*, which, though it have not ſtrength enough to attract the Bullet *C* directly from the Ground, yet may do it by the help of the Plane *E F*. Now, when the Bullet is come to the top of this Plane, its own Gravity (which is ſuppoſed to exceed the ſtrength

of

of the Loadſtone) will make it fall into that Hole at *E*; and the force it receives in this fall, will carry it with ſuch a violence unto the other end of this Arch, that it will open the Paſſage which is there made for it, and by its return will again ſhut it; ſo that the Bullet, (as at the firſt) is in the ſame Place whence it was attracted, and conſequently muſt move perpetually.

But however this Invention may ſeem to be of ſuch ſtrong probability, yet there are ſundry Particulars which may prove it inſufficient: For,

1. This Bullet of Steel muſt firſt be touched, and have its ſeveral Poles, or elſe there can be little or no Attraction of it. Suppoſe *C* in the Steel to be anſwerable unto *A* in the Stone, and to *B*; in the Attraction, *C D* muſt always be directed anſwerable to *A B*, and ſo the Motion will be more difficult, by reaſon there can be no Rotation, or turning round of the Bullet, but it muſt ſlide up with the Line *C D*, anſwerable to the Axis *A B*.

2. In its fall from *E* to *G*, which is *motus elementaris*, and proceeds from its Gravity, there muſt needs be a Rotation of it, and ſo 'tis odds but it happens wrong in the riſe, the Poles in the Bullet being not in the ſame Direction to thoſe in the Magnet: And if in this Reflux, it ſhould ſo fall out, that *D* ſhould be directed towards *B*, there ſhould be rather a Flight than an Attraction, ſince thoſe two ends do *repel*, and not draw one another.

3. If the Loadſtone *A B* have ſo much ſtrength, that it can attract the Bullet in *F* when it is not turned round, but does only ſlide upon the Plane, whereas its own Gravity would rowl it downwards; then it is evident, the Sphere of its Activity and Strength would be ſo increaſed when it approaches much nearer, that it would not need the aſſiſtance of the Plane, but would draw it immediately to it ſelf without that help; and ſo the Bullet would not fall

down through the Hole, but aſcend to the Stone, and conſequently ceaſe its Motion: For, if the Loadſtone be of force enough to draw the Bullet on the Plane, at the diſtance *F B*, then muſt the ſtrength of it be ſufficient to attract it immediately unto it ſelf, when it is ſo much nearer as *E B*. And if the Gravity of the Bullet be ſuppoſed ſo much to exceed the ſtrength of the Magnet, that it cannot draw it directly when it is ſo near, then will it not be able to attract the Bullet up the Plane, when it is ſo much further off.

So that none of all theſe Magnetical Experiments, which have been as yet diſcovered, are ſufficient for the effecting of a perpetual Motion, though theſe kind of Qualities ſeem moſt conducible unto it, and perhaps hereafter it may be contrived from them.

CHAP. XIV.

The ſeeming Probability of effecting a continual Motion by ſolid Weights, in a hollow Wheel or Sphere.

THE third way whereby the making of a perpetual Motion hath been attempted, is by the natural Affection of Gravity; when the Heavineſs of ſeveral Bodies is ſo contrived, that the ſame Motion which they give in their Deſcent, may be able to carry them up again.

But, (againſt the Poſſibility of any ſuch Invention) it is thus objected by *Cardan*. All Sublunary Bodies have a direct Motion either of Aſcent, or Deſcent; which, becauſe it does refer to ſome Term, therefore cannot be perpetual, but muſt needs ceaſe, when it is arrived at the Place unto which it naturally tends.

Subtil. l. 17. De Var. Rerum, l. 9. c. 48.

I an-

I anſwer, Though this may prove that there is no Natural Motion of any particular heavy Body, which is perpetual, yet it doth not hinder, but that it is poſſible from them to contrive ſuch an artificial Revolution, as ſhall conſtantly be the cauſe of it ſelf.

Thoſe Bodies which may be ſerviceable to this purpoſe, are diſtinguiſhable into two kinds.

1. Solid and Conſiſtent, as Weights of Metal, or the like.

2. Fluid, or Sliding; as Water, Sand, *&c.*

Both theſe ways have been attempted by many, though with very little or no ſucceſs. Other Mens Conjectures in this kind you may ſee ſet down by divers Authors. It would be too tedious to repeat them over, or ſet forth their Draughts. I ſhall only mention two new ones, which (if I am not over-partial) ſeem altogether as probable as any of theſe kinds that have been yet invented; and till Experience had diſcovered their Defect and Inſufficiency, I did certainly conclude them to be Infallible.

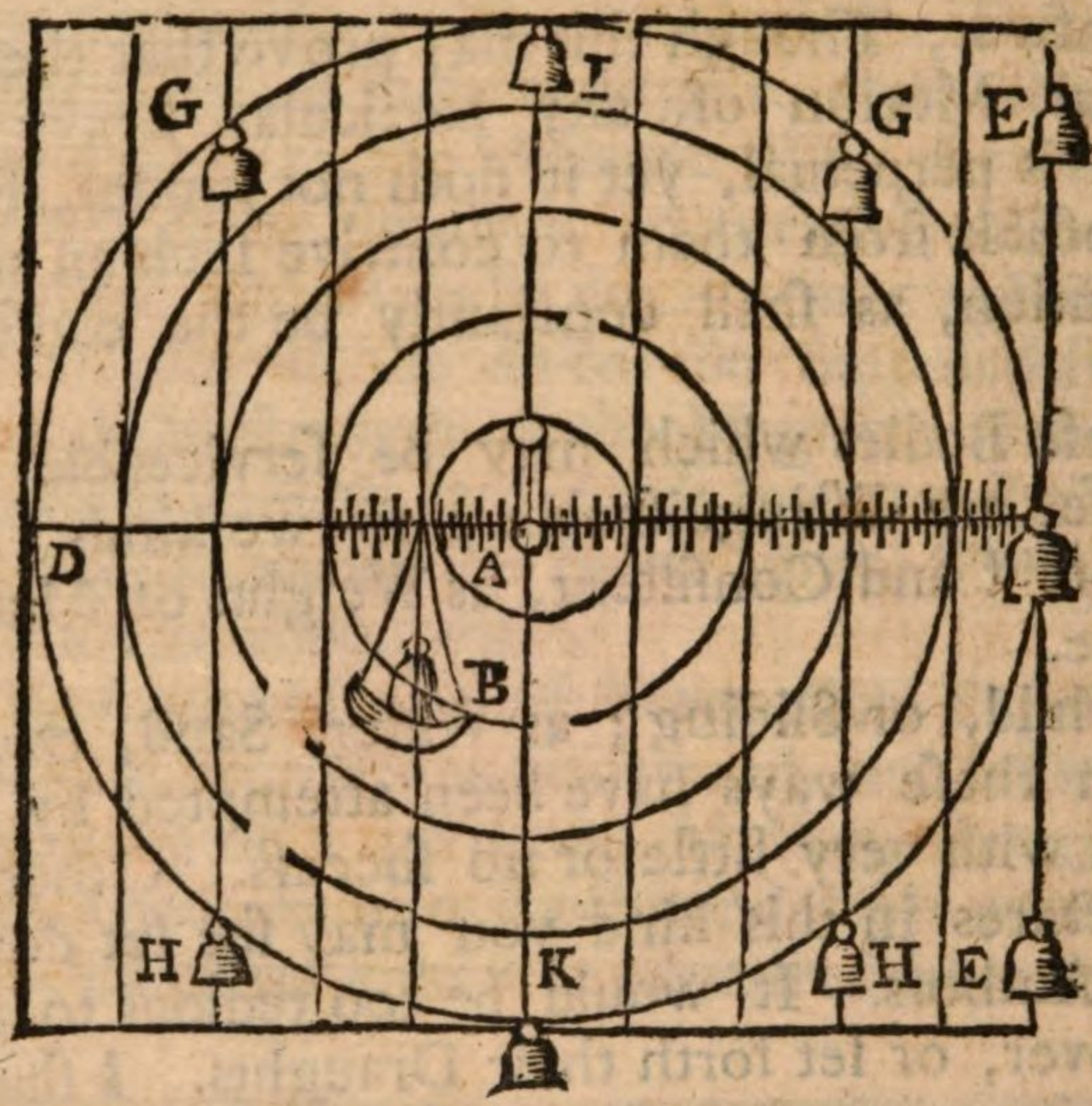
D. Flud. *Tract.* 2. *pars* 7. *l.* 2. *c.* 4. & 7.

The firſt of theſe Contrivances was by ſolid Weights being placed in ſome hollow Wheel or Sphere, unto which they ſhould give a perpetual Revolution: For (as the Philoſopher hath largely proved) only a Circular Motion can properly be perpetual.

Ariſt. Phyſ. l. 8. *c.* 12.

But for the better conceiving of this Invention, it is requiſite that we rightly underſtand ſome Principles in *Trochilicks*, or the Art of Wheel-Inſtruments: As chiefly, the Relation betwixt the Parts of a Wheel, and thoſe of a Ballance; the ſeveral Proportions in the Semidiameter of a Wheel, being anſwerable to the Sides in a Ballance, where the Weight is multiplied according to its diſtance from the Center.

Ariſt. Mechan. c. 2. *De ratione libræ ad circulum.*

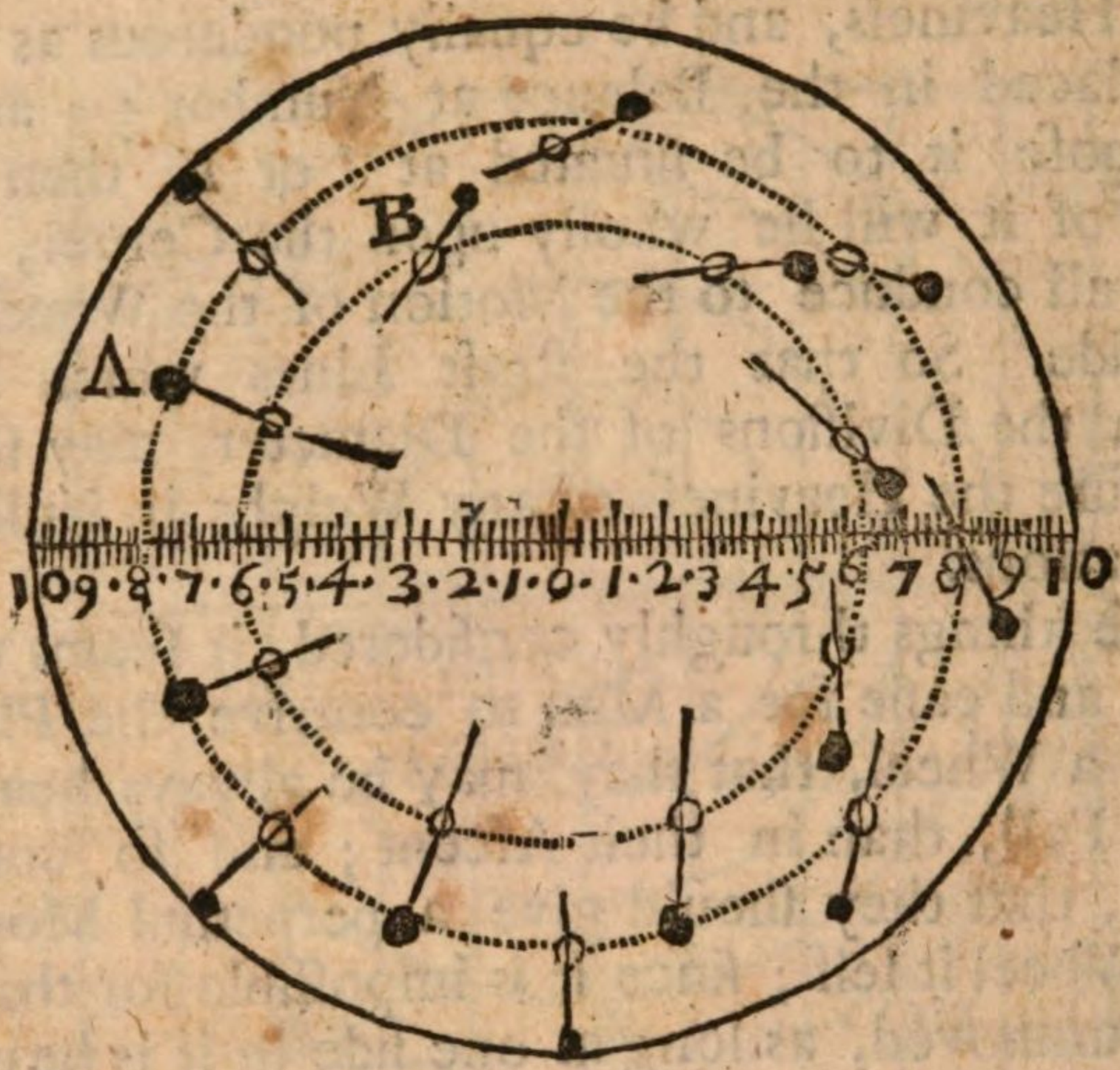


Thus, ſuppoſe the Center to be at *A*, and the Diameter of the Wheel *D C* to be divided into equal Parts (as is here expreſſed) it is evident, according to the former Ground, that one Pound at *C* will equiponderate to Five Pound at *B*, becauſe there is ſuch a proportion betwixt their ſeveral Diſtances from the Center. And it is not material, whether or no theſe ſeveral Weights be placed Horizontally; for though *B* do hang lower than *C*, yet this does not at all concern the Heavineſs; or though the Plummet *C* were placed much higher than it is at *E*, or lower at *F*, yet would it ſtill retain the ſame Weight which it had at *C*; becauſe theſe Plummets (as in the Nature of all heavy Bodies) do tend downwards by a ſtrait Line: So that their ſeveral Gravities are to be meaſured by that part of the Horizontal Semidiameter, which is directly either below or above them. Thus when the Plummet *C* ſhall be moved either to *G* or *H*, it will loſe $\frac{1}{3}$ of its for-

former Heavineſs, and be equally ponderous as if it were placed in the Balance at Number 3; and if we ſuppoſe it to be ſituated at *I* or *K*, then the Weight of it will lie wholly upon the Center, and not at all conduce to the Motion of the Wheel on either ſide. So that the ſtrait Lines which paſs through the Diviſions of the Diameter, may ſerve to meaſure the Heavineſs of any Weight in its ſeveral Situations.

Theſe things throughly conſidered, it ſeems very poſſible and eaſie for a Man to contrive the Plummets of a Wheel, that they may be always heavier in their Fall, than in their Aſcent; and ſo conſequently, that they ſhould give a perpetuul Motion to the Wheel it ſelf; ſince it is impoſſible for that to remain unmoved, as long as one ſide in it is heavier than the other.

For the performance of this, the Weights muſt be ſo ordered, 1. That in their Deſcent they may fall from the Center, and in their Aſcent may riſe nearer to it. 2. That the Fall of each Plummet may begin the Motion of that which ſhould ſucceed it. As in this following Diagram.



Where there are 16 Plummets, 8 in the inward Circle, and as many in the outward, (the inequality being to ariſe from their Situation, it is therefore moſt convenient that the Number of them be even.) The 8 inward Plummets are ſuppoſed to be in themſelves ſo much heavier than the other, that in the Wheel they may be of equal Weight with thoſe above them, and then the Fall of theſe will be of ſufficient Force to bring down the other. For Example, if the outward be each of them Four Qunces, then the inward muſt be Five; becauſe the outward is diſtant from the Center Five of thoſe Parts, whereof the inward is but Four. Each Pair of theſe Weights ſhould be joined together by a little String or Chain, which muſt be faſtned about the middle, betwixt the Bullet and the Center of that Plummet which is to fall firſt, and at the Top of the other.

When theſe Bullets in their Deſcent are at their fartheſt Diſtance from the Center of the Wheel, then

ſhall

ſhall they be ſtopped, and reſt on the Pins placed to that Purpoſe ; and ſo in their riſing, there muſt be other Pins to keep them in a convenient Poſture and Diſtance from the Center, leſt approaching too near unto it, they thereby become unfit to fall, when they ſhall come to the Top of the deſcending Side.

This may be otherwiſe contrived with ſome different Circumſtances, but they will all redound to the ſame Effect. By ſuch an Engine it ſeems very probable, that a Man may produce a perpetual Motion. The Diſtance of the Plummets from the Center increaſing their Weight on one Side, and their being tied to one another, cauſing a conſtant Succeſſion in their falling,

But now, upon Experience I have found this to be fallacious, and the Reaſon may ſufficiently appear by a Calculation of the Heavineſs of each Plummet, according to its ſeveral Situation ; which may eaſily be done by thoſe Perpendiculars that cut the Diameter, (as was before explained, and is here expreſſed in 5 of the Plummets on the deſcending Side.) From ſuch a Calculation it will be evident, that both the Sides of this Wheel will equiponderate ; and ſo conſequently that the ſuppoſed Inequality whence the Motion ſhould proceed, is but Imaginary and Groundleſs. On the deſcending Side, the Heavineſs of each Plummet may be meaſured according to theſe Numbers, (ſuppoſing the Diameter of the Wheel to be divided into Twenty Parts, and each of thoſe ſubdivided into Four.)

The outward Plummets.

$$\left\langle \begin{matrix} 7 & 0 \\ 10 & 0 \\ 7 & 0 \end{matrix} \right\rangle \text{ The Sum } 24.$$

The inward Plummets.

$$\left\langle \begin{matrix} 1 & 0 \\ 7 & 2 \\ 7 & 2 \\ 3 & 0 \end{matrix} \right\rangle \text{ The Sum } 19.$$

On the aſcending Side, the Weights are to be reckoned according to theſe Degrees.

The outward.			*The inward.*		
1	3		4	1	
7	2		7	0	*The Sum*
9	0	*The Sum* 24.	5	2	19.
5	3		2	1	
0	0				

The Sum of which laſt Numbers is equal with the former, and therefore both the Sides of ſuch a Wheel, in this Situation will equiponderate.

If it be objected, that the Plummet *A* ſhould be contrived to pull down the other at *B*, and then the deſcending Side will be heavier than the other.

For anſwer to this, it is conſiderable,

1. That theſe Bullets towards the Top of the Wheel, cannot deſcend till they come to a certain kind of Inclination.

2. That any lower Bullet hanging upon the other above it, to pull it down, muſt be conceived, as if the Weight of it were in that Point where its String touches the upper; at which Point this Bullet will be of leſs Heavineſs in reſpect of the Wheel, than if it did reſt in its own Place: So that both the Sides of it, in any kind of Situation may equiponderate.

CHAP.

CHAP. XV.

Of compoſing a perpetual Motion by fluid Weights. Concerning Archimedes *his Water-Screw. The great Probability of accompliſhing this Enquiry by the Help of that; with the Falliblenеſs of it upon Experiment.*

THat which I ſhall mention as the laſt Way, for the Trial of this Experiment, is by contriving it in ſome Water-Inſtrument; which may ſeem altogether as probable and eaſie as any of the reſt; becauſe that Element by reaſon of its fluid and ſubtle Nature (whereby of its own accord it ſearches out the lower and more narrow Paſſages) may be moſt pliable to the Mind of the Artificer. Now the uſual Means for the Aſcent of Water, is either by *Suckers* or *Forces*, or ſomething equivalent thereunto: Neither of which may be conveniently applied unto ſuch a Work as this, becauſe there is required unto each of them ſo much or more Strength, as may be anſwerable to the full Weight of the Water that is to be drawn up; and then beſides, they move for the moſt part by Fits and Snatches, ſo that it is not eaſily conceivable, how they ſhould conduce unto ſuch a Motion, which by reaſon of its Perpetuity muſt be regular and equal.

But amongſt all other ways to this Purpoſe, that Invention of *Archimedes* is incomparably the beſt, which is uſually called *Cochlea*, or the *Water-ſcrew*; being framed by the helical Revolution of a Cavity about a Cylinder. We have not any Diſcourſe from the Author himſelf concerning it, nor is it certain whether he ever writ any thing to this Purpoſe. But if he did, yet as the Injury of Time hath deprived us of many other his excellent Works, ſo likewiſe of this amongſt the Reſt. *Athæn-*

Deipnoſop. l. 5. *Athenæus* ſpeaking of that great Ship built by *Hiero*, in the framing of which, there were Three hundred Carpenters employed for a Year together, beſides many other Hirelings for Carriages, and ſuch ſervile Works; mentions this Inſtrument as being inſtead of a Pump for that vaſt Ship; by the Help of which, one Man might eaſily and ſpeedily drain out the Water, though it were very deep.

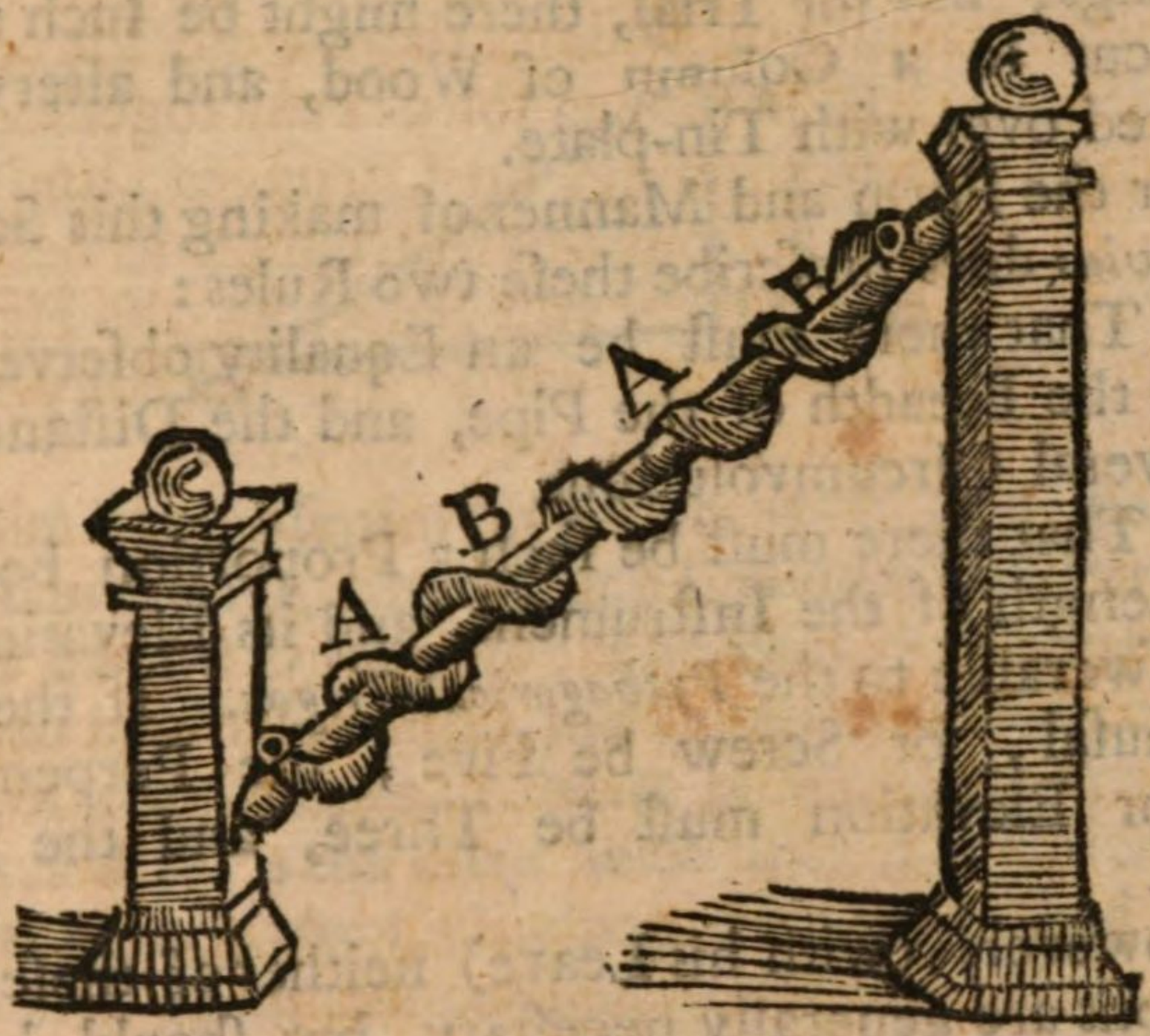
Biblioth. l. 1. *Diodorus Siculus* ſpeaking of this Engine, tells us, that *Archimedes* invented it when he was in *Egypt*, and that it was uſed in that Countrey, for the draining of thoſe Pits and lower Grounds, whence the Waters of *Nilus* could not return. Φιλοτέχνως δ' ὄντως τῷ ὀργάνῳ κεχρῆσθαι, (ſaith the ſame Author.) It being an Engine ſo Ingenious and Artificial, as cannot be ſufficiently expreſſed or commended. And ſo (it ſhould ſeem) the Smith in *Milan* conceived it to be, who having without any Teaching or Information found it out, and therefore thinking himſelf to be the firſt Inventor, fell mad with the meer Joy of it.

Cardan. Subtil. l. 1. De ſapient. l. 5.

The Nature and Manner of making this, is more largely handled by *Vitruvius*.

Architect. l. 10. c. 11. The Figure of it is after this Manner.

Where



Where you ſee there is a Cylinder *AA*, and a ſpiral Cavity or Pipe twining about it, according to equal Revolutions *BB*. The Axis and Centers of its Motions are at the Points *C D*; upon which being turned, it will ſo happen, that the ſame part of the Pipe which was now lowermoſt, will preſently become higher, ſo that the Water does aſcend by deſcending; aſcending in compariſon to the whole Inſtrument, and deſcending in reſpect of its ſeveral Parts. This being one of the ſtrangeſt Wonders amongſt thoſe many wherein theſe Mathematical Arts do abound, that a heavy Body ſhould riſe by falling down, and the farther it paſſes by his own natural Motion of Deſcent, by ſo much higher ſtill ſhall it aſcend; which though it ſeem ſo evidently to contradict all Reaſon and Philoſophy, yet in this Inſtrument it may be manifeſted both by Demonſtration and Senſe.

This Pipe or Cavity, for the Matter of it, cannot eaſily be made of Metal, by reaſon of its often turn-

turnings; but for Trial, there might be such a Cavity cut in a Column of Wood, and afterwards covered over with Tin-plate.

For the Form and Manner of making this Screw, *Vitruvius* does prescribe these two Rules:

1. That there must be an Equality observed betwixt the Breadth of the Pipe, and the Distance of its several Circumvolutions.

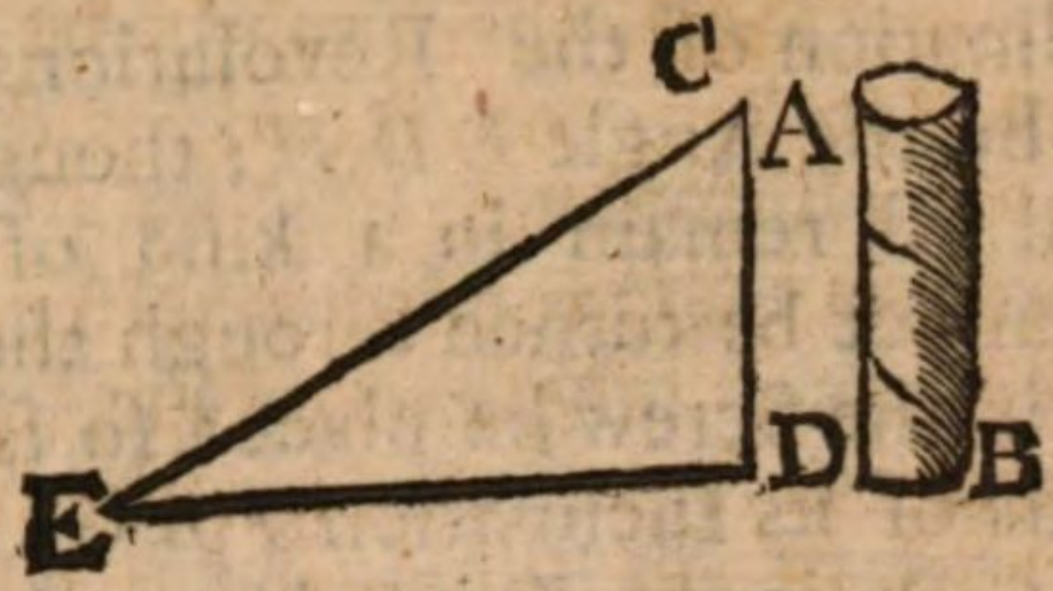
2. That there must be such a Proportion betwixt the Length of the Instrument, and its Elevation, as is answerable to the *Pythagorical Trigon*. If the Hypotenusal, or Screw be Five, the Perpendicular or Elevation must be Three, and the Basis Four.

David Rivalt. Com. in Archim. operaexter.

However, (with his Leave) neither of these Proportions are generally necessary, but should be varied according to other Circumstances. As for the Breadth of the Pipe in respect of its Revolutions, it is left at Liberty, and may be contrived according to the Quantity of Water which it should contain. The chief thing to be considered, is the Obliquity or Closeness of these Circumvolutions. For the nearer they are unto one another, the higher may the Instrument be erected; there being no other guide for its true Elevation but this.

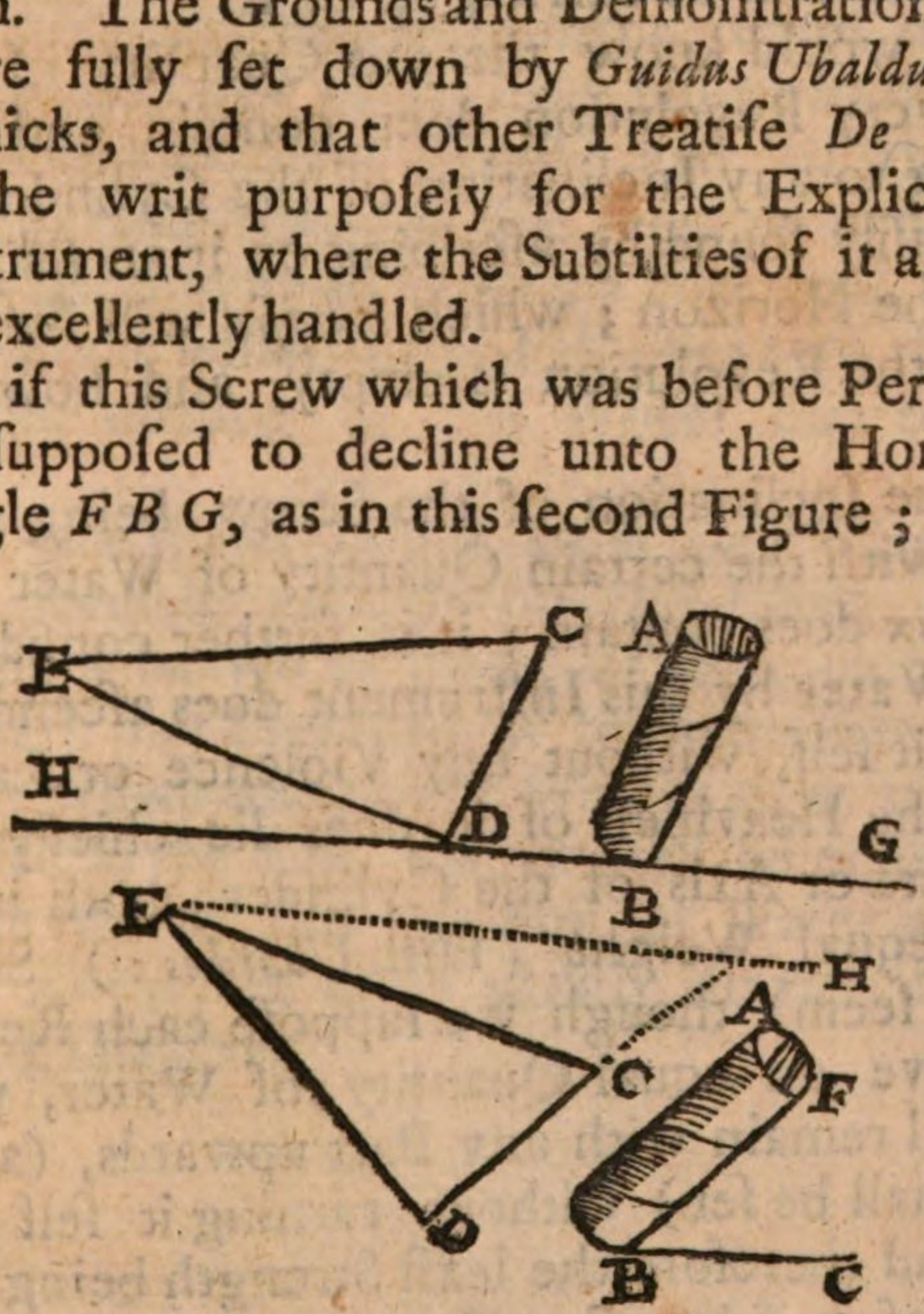
And because the right understanding of this particular is one of the principal Matters that concerns the use of this Engine, therefore I shall endeavour with Brevity and Perspicuity to explain it. The first thing to be enquired after, is, what kind of Inclination these Helical Revolutions of the Cylinder have unto the Horizon; which may be thus found out.

Let



Let *A B* repreſent a Cylinder with two perfect Revolutions in it, unto which Cylinder the Perpendicular Line *C D* is equal: The Baſis *D E* being ſuppoſed to be double unto the Compaſs or Circumference of the Cylinder. Now it is certain, that the Angle *C E D*, is the ſame with that by which the Revolutions on the Cylinder are framed, and that the Line *E C*, in comparifon to the Baſis *E D*, does ſhew the Inclination of theſe Revolutions unto the Horizon. The Grounds and Demonſtration of this, are more fully ſet down by *Guidus Ubaldus*, in his Mechanicks, and that other Treatiſe *De Cochlea*, which he writ purpoſely for the Explication of this Inſtrument, where the Subtilties of it are largely and excellently handled.

Now if this Screw which was before Perpendicular, be ſuppoſed to decline unto the Horizon by the Angle *F B G*, as in this ſecond Figure;



then

then the Inclination of the Revolutions in it will be increaſed by the Angle *E D H*; though theſe Revolutions will ſtill remain in a kind of Aſcent, ſo that Water cannot be turned through them.

But now, if the Screw be placed ſo far declining, that the Angle of its Inclination *F B G*, be leſs than the Angle *E C D*, in the Triangle; as in this other Diagram under the former; then the Revolutions of it will deſcend to the Horizon, as does the Line *E C*; and in ſuch a Poſture, if the Screw be turned round, Water will aſcend through its Cavity. Whence it is eaſie to conceive the certain Declination, wherein any Screw muſt be placed for its own Conveyance of Water upwards. Any Point betwixt *H* and *D* being in deſcent, but yet the more the Screw declines downwards towards *D*, by ſo much the more Water will be carried up by it.

See a further explication of this in *Ubaldus de Cochlea, l. 2. prop. 25.*

If you would know the juſt Quantity of Water which every Revolution does contain and carry, according to any Inclination of the Cylinder; this may be eaſily found, by aſcribing on it an *Ellipſis*, parallel to the Horizon; which *Ellipſis* will ſhew how much of the Revolution is empty, and how much full.

Ibid. 3. prop. 4.

The true Inclination of the Screw being found, together with the certain Quantity of Water which every *Helix* does contain; it is further conſiderable, that the Water by this Inſtrument does aſcend naturally of it ſelf, without any Violence or Labour; and that the Heavineſs of it does lie chiefly upon the Centers or Axis of the Cylinder, both its ſides being of equal Weight (ſaith *Ubaldus*:) So that (it ſhould ſeem) though we ſuppoſe each Revolution to have an equal Quantity of Water, yet the Screw will remain with any Part upwards, (according as it ſhall be ſet) without turning it ſelf either way. And therefore the leaſt Strength being added to either of its ſides, ſhould make it deſcend, according

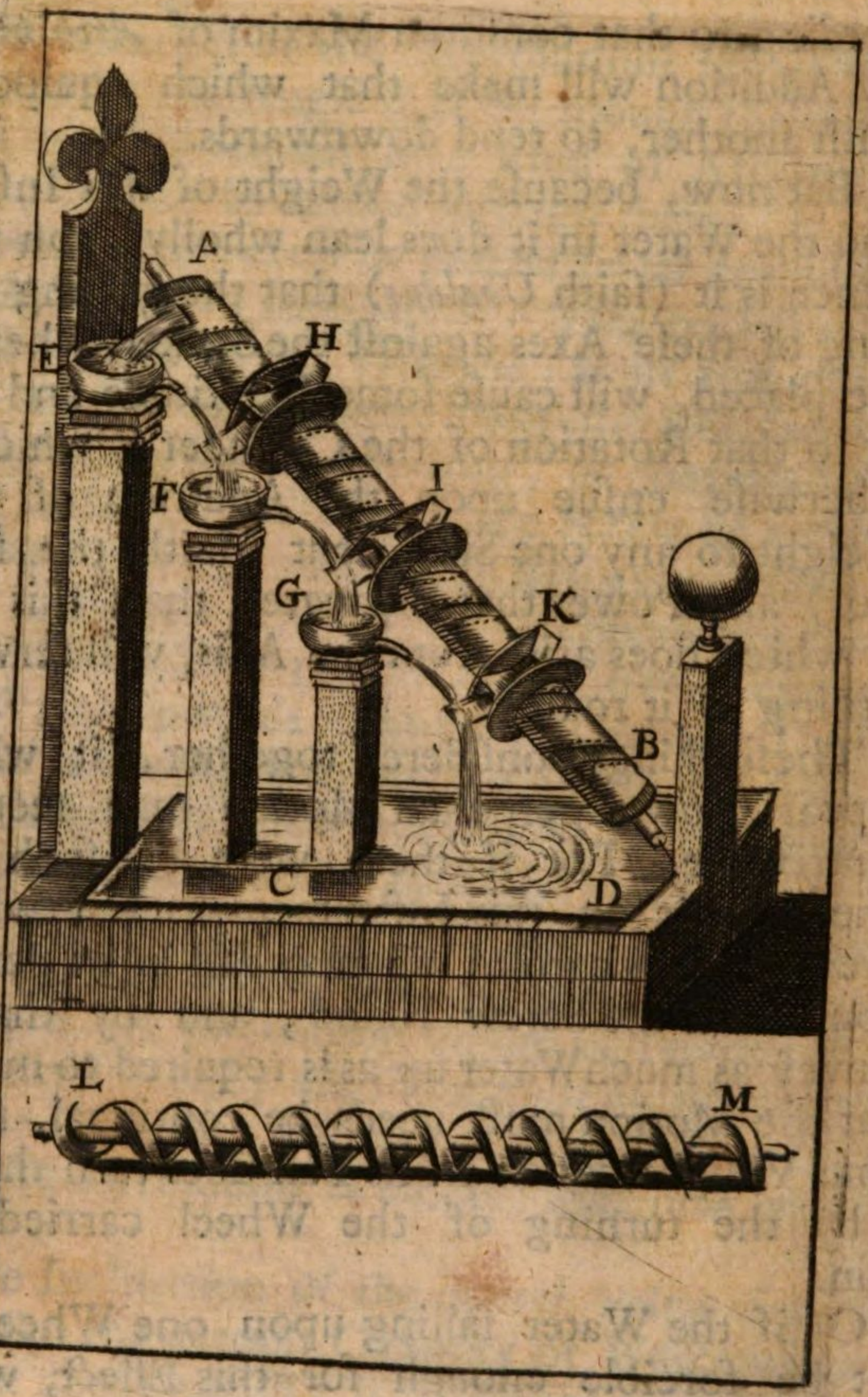
cording to that common Maxim of *Archimedes*; any Addition will make that which equiponderates with another, to tend downwards. *De Æquipond. Suppos.* 3.

But now, becauſe the Weight of this Inſtrument, and the Water in it does lean wholly upon the Axis, hence is it (ſaith *Ubaldus*) that the grating and rubbing of theſe Axes againſt the Sockets wherein they are placed, will cauſe ſome Ineptitude and Reſiſtency to that Rotation of the Cylinder; which would otherwiſe enſue upon the Addition of the leaſt Weight to any one Side; but (ſaith the ſame Author) any Power that is greater than this Reſiſtency which does ariſe from the Axis, will ſerve for the turning of it round.

Theſe things conſidered together, it will hence appear, how a perpetual Motion may ſeem eaſily contrivable. For if there were but ſuch a Water-wheel made on this Inſtrument, upon which the Stream that is carried up may fall in its deſcent, it would turn the Screw round, and by that Means convey as much Water up as is required to move it; ſo that the Motion muſt needs be continual, ſince the ſame Weight which in its Fall does turn the Wheel, is by the turning of the Wheel carried up again.

Or if the Water falling upon one Wheel, would not be forcible enough for this Effect, why then there might be two or three, or more, according as the Length and Elevation of the Inſtrument will admit: By which means, the Weight of it may be ſo multiplied in the Fall, that it ſhall be equivalent to twice or thrice that quantity of Water which aſcends. As may be more plainly diſcerned by this following Diagram.

Where



Where the Figure *L M*, at the Bottom, does repreſent a wooden Cylinder with helical Cavities cut in it; which at *A B*, is ſuppoſed to be covered over with Tin-plates, and three Water-wheels upon it *H I K*. The lower Ciſtern which contains the Water being *C D*. Now this Cylinder being turned round, all the Water which from the Ciſtern aſcends through it, will fall into the Veſſel at *E*, and from that Veſſel being conveyed upon the Water-wheel *H*, ſhall conſequently give a circular Motion to the whole

whole Screw: Or if this alone ſhould be too weak for the turning of it, then the ſame Water which falls from the Wheel *H*, being received into the other Veſſel *F*, may from thence again deſcend on the Wheel *I*; by which means the force of it will be doubled. And if this be yet inſufficient, then may the Water which falls on the ſecond Wheel *I*, be received into the other Veſſel *G*, and from thence again deſcend on the third Wheel at *K*: And ſo for as many other Wheels as the Inſtrument is capable of. So that beſides the greater Diſtance of theſe three Streams from the Center or Axis, by which they are made ſo much heavier, and beſides, that the Fall of this outward Water is forcible and violent, whereas the Aſcent of that within is natural; beſides all this, there is thrice as much Water to turn the Screw, as is carried up by it.

There is another like contrivance to this purpoſe in *Pet. Bettin. Apiar.* 4. *Pogym.* 1. *Prop.* 10. but with much leſs advantage than 'tis here propoſed.

But on the other ſide, if all the Water falling upon one Wheel, would be able to turn it round, then half of it would ſerve with two Wheels; and the reſt may be ſo diſpoſed of in the Fall, as to ſerve unto ſome other uſeful delightful Ends.

When I firſt thought of this Invention, I could ſcarce forbear with *Archimedes* to cry out εὕρηκα, εὕρηκα; it ſeeming ſo infallible a way for the effecting of a perpetual Motion, that nothing could be ſo much as probably objected againſt it: But upon Trial and Experience I find it altogether inſufficient for any ſuch Purpoſe, and that for theſe two Reaſons:

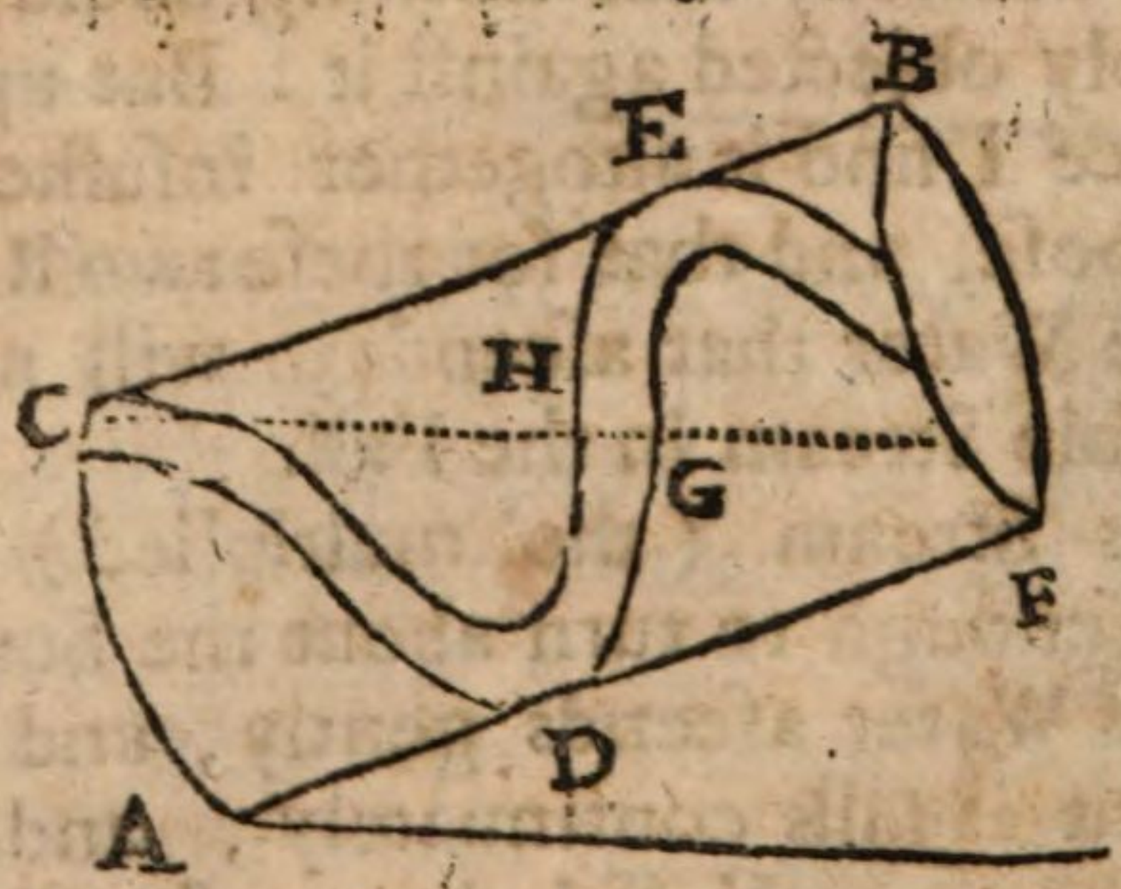
1. The Water that aſcends, will not make any conſiderable Stream in the Fall.

2. This Stream (tho' multiplied) will not be of Force enough to turn about the Screw.

1. The Water aſcends gently, and by Intermiſſions; but it falls continuately, and with Force; each of the three Veſſels being ſuppoſed full at the firſt, that ſo the Weight of the Water in them might add the greater Strength and Swiftneſs to the

Streams, that descend from them. Now this Swiftness of Motion will cause so great a Difference betwixt them, that one of these little Streams may spend more Water in the Fall, than a Stream six times bigger in the Ascent, tho' we should suppose both of them to be continuate: How much more then, when as the ascending Water is vented by Fits and Intermissions; every Circumvolution voiding only so much as is contained in one *Helix*? And in this particular, one that is not versed in these kind of Experiments, may be easily deceived.

But *Secondly*, tho' there were so great a Disproportion, yet notwithstanding, the Force of these outward Streams might well enough serve for the turning of the Screw; if it were so, that both its sides would equiponderate the Water being in them (as *Ubaldus* hath affirmed.) But now, upon farther Examination, we shall find this Assertion of his to be utterly against both Reason and Experience. And herein does consist the chief Mistake of this Contrivance: For the ascending side of the Screw is made by the Water contained in it, so much heavier than the descending side, that these outward Streams thus applied, will not be of force enough to make them equiponderate, much less to move the whole; as may be more easily discern'd by this Fig.



Where *A B* represents a Screw cover'd over, *C D E* one *Helix*, or Revolution of it, *C D* the Ascending

cending ſide, *E D* the Deſcending ſide, the Point *D* the middle. The Horizontal Line *C F*, ſhewing how much of the *Helix* is filled with Water, *viz.* of the Aſcending ſide, from *C* the beginning of the *Helix*, to *D* the middle of it; and on the Deſcending ſide, from *D* the middle, to the Point *G*, where the Horizontal does cut the *Helix*. Now it is evident, that this latter part *D G*, is nothing near ſo much, and conſequently not ſo heavy as the other *D C*. And thus is it in all the other Revolutions; which, as they are either more or larger, ſo will the Difficulty of this Motion be increaſed. Whence it will appear, that the outward Streams which deſcend, muſt be of ſo much Force, as to countervail all that Weight whereby the Aſcending ſide in every one of theſe Revolutions does exceed the other. And tho' this may be effected by making the Water-wheels larger, yet then the Motion will be ſo ſlow, that the Screw will not be able to ſupply the outward Streams.

There is another Contrivance to this purpoſe, mentioned by *Kircher de Magnete*, *l.* 2. *p.* 4. depending upon the Heat of the Sun, and the Force of Winds; but it is liable to ſuch abundance of Exceptions, that it is ſcarce worth the mentioning, and does by no means deſerve the Confidence of any Ingenious Artiſt.

Thus have I briefly explained the Probabilities and Defects of thoſe ſubtle Contrivances, whereby the making of a perpetual Motion hath been attempted. I would be loth to diſcourage the Enquiry of any ingenious Artificer, by denying the Poſſibility of effecting it with any of theſe Mechanical Helps: But yet (I conceive) if thoſe Principles which concern the Slowneſs of the Power, in compariſon to the Greatneſs of the Weight, were rightly underſtood, and throughly conſidered, they would make this Experiment to ſeem (if not altoge-

Treated of before, *l.* 1. *c.*

together impossible, yet) much more difficult than otherwise perhaps it will appear. However, the Enquiring after it cannot but deserve our Endeavours, as being one of the most noble amongst all these Mechanical Subtilties. And (as it is in the Fable of him who dug the Vineyard for a hid Treasure, tho' he did not find the Money, yet he thereby made the Ground more fruitful; so) tho' we do not attain to the effecting of this particular; yet our searching after it may discover so many other excellent Subtilties, as shall abundantly recompence the Labour of our Enquiry.

And then besides, it may be another Encouragement, to consider the Pleasure of such Speculations, which do ravish and sublime the Thoughts with more clear Angelical Contentments. *Archimedes* was generally so taken up in the Delight of these Mathematical Studies of this familiar *Siren*, (as *Plutarch* stiles them) that he forgot both his Meat and Drink, and other Necessities of Nature; nay, that he neglected the saving of his Life, when that rude Soldier, in the Pride and Haste of Victory, would not give him leisure to finish his Demonstration. What a Ravishment was that, when having found out the way to measure *Hiero*'s Crown, he leaped out of the Bath, and (as if he were suddenly possess'd) ran naked up and down, crying, εὕρηκα, εὕρηκα! It is storied of *Thales*, that in his Joy and Gratitude for one of these Mathematical Inventions, he went presently to the Temple, and there offer'd up a solemn Sacrifice. And *Pythagoras*, upon the like Occasion, is related to have sacrificed a Hundred Oxen. The Justice of Providence having so contriv'd it, that the Pleasure which there is in the Success of such Inventions, should be proportioned to the great Difficulty and Labour of their Enquiry.

διηλίας καὶ συνοίκους σειρῆνος. *Plutarch. Marcell. Joan. Tzetzes, Chil. 2. Hist. 35. Valer. Maxim. l. 8. c. 7.*

FINIS.

AN ABSTRACT OF Dr. *WILKINS*'s ESSAY Towards a Real Character, AND A Philosophical Language.

Which was Printed by Order of the *Royal Society*, 1668.

IT appears by the Author's Dedication to the President, Council and Fellows of the *Royal Society*, that they had several Times requir'd his Papers of him relating to this Subject, and that in obedience to their Orders, he had reduced them into Method. He tells them, he was not so vain as to think he had finish'd this great Undertaking with all the Advantages of which it was capable: Nor was he so diffident of his Essay, but that he thought it sufficient for what it pretended to, *viz.* the distinct Expression of all Things and Notions that fall under Discourse. He was sensible of sundry Defects in several parts of the Book, and therefore desired they

would appoint some of their Number to consider the whole, and to offer their Observations as to what they thought fit to be amended. Accordingly several of the Society, as appears by the Philosophical Transactions of *Monday*, *May*, 18. 1668. were appointed to answer his Desire, for the furthering and facilitating the Practice of what he aim'd at. But what Progress they made in it does not appear. Our Author was sensible that his Design might lie neglected as other good Designs had done; and the only Expedient he could think of to prevent it, was, that it might be sent abroad with the Approbation of the Royal Society, which might provoke at least the Learned part of the World to take notice of, and encourage it, according as they should think it deserv'd.

The Advantages proposed by this Philosophical **Language** were, The facilitating of mutual Commerce among the several Nations of the World; the improving of Natural Knowledge; and the Propagation of Religion: Our Author was also of Opinion, that it might contribute much to the clearing of some Modern Differences in Religion, by unmasking many wild Errors that shelter themselves under the Disguise of Affected Phrases; which being philosophically unfolded, and rendred according to the Genuine and Natural Importance of Words, would appear to be Inconsistencies and Contradictions; and several of those pretended Mysterious Profound Notions, express'd in Big Swelling Words, by which Men set up for Reputation, being this way examin'd, would either appear to be Nonsense, or very jejune. But whatever might be the issue of this Attempt, as to the establishing of a Real Character, and bringing it into common Use among several Nations of the World, of which our Author had but very slender Expectations, yet of this he was confident, that the reducing of all Things and Notions to such kind of

Tables

Tables as he proposed, were it as compleatly done as it might be, would prove the shorteſt and plaineſt Way for the attainment of Real Knowledge, that had yet been offer'd to the World. To which he added, That he thought his Tables, as now they are, were a much better and readier Course for training up Men in the knowledge of Things, than any other Way that he knew of. And inded since his Design of the Real Character is wholly neglected, that seems now to be the principal use of the Book, and alone makes it truly valuable.

In his Preface to the Reader he gives an Account how he came to engage in this Work, *viz.* That by his Converse with Dr. *Seth Ward*, then Bishop of *Salisbury*, upon the various *Desiderata*, proposed by Learned Men to be still wanting to the Advancement of several parts of Learning, he found this of an *Universal Character*, to be one of the principal and most feasible, if regularly prosecuted; but most of those who had attempted any thing like it, mistook their Foundation, by proposing a Character according to some particular Language, without reference to the Nature of Things, and that Common Notion of them wherein Mankind agrees: This Suggestion gave him the first distinct Apprehension of the proper Course to be taken for advancing such a Design.

He says it was a considerable time after this before he attempted it; and the first Occasion of it was; his desire to assist another Person in framing a Real Character from the Natural Notion of Things. In order to promote that Person's Design, he drew up the Tables of Substances, or the Species of Natural Bodies, reduced under their several Heads, much the same as they are publish'd in this Essay. But the Person thinking this Method of too great a compass, and conceiving that he could provide for all the chief Radicals in a much shorter and easier Way, he did not make use of the Doctor's Tables. Our Author

however being convinc'd that this was the only way to effect ſuch a Work, and being unwilling to loſe ſo much Pains, he went on with the other Tables of Accidents, and then attempted the reduction of all other Words in the Dictionary to theſe Tables, either as they were ſynonimous to them, or to be defin'd by 'em; which was a true way to try the Fulneſs of thoſe Tables, and likewiſe a Help to Learners, who without ſuch a Direction, might not perhaps be able at firſt to find out the true Place and Notion of many Words.

For the farther compleating of this Work, out Author found it neceſſary to frame ſuch a Natural Grammar, as might be ſuited to the Philoſophy of Speech, abſtracting from many unneceſſary Rules belonging to inſtituted Languages.

He takes notice of the Aſſiſtance he receiv'd from his Learned Friends in ſeveral Faculties; particularly from Mr. *Francis Willoughby*, as to the ſeveral Species of Animals; from Mr. *John Ray*, as to the Tables of Plants; and for the other principal Difficulties from Dr. *William Lloyd*, than whom he knew none fitter, becauſe of his Accurate Judgment in Philology and Philoſophy; and to him particularly he ow'd the ſuiting the Tables to the Dictionary, and the drawing up of the Dictionary it ſelf, which he doubts not will be found the moſt perfect ever yet made for the *Engliſh* Tongue.

'Tis obſervable however, that though he mentions others of his Friends by Name, from whom he had any Light or Help towards this Deſign, he does not at all name Mr. *George Dalgarno*, a *Scotch* Gentleman, born at *Aberdeen*, and bred in the Univerſity there, who printed a Book upon the ſame Subject, and with the ſame View, before him. This is the more remarkable, becauſe Dr. *Wilkins*'s own Name is printed in the Margin of King *Charles* the IId's Letter, prefix'd to Mr. *Dalgarno*'s Book, as one of thoſe who in-

form'd

form'd his Majeſty of Mr. *Dalagarno*'s Deſign; and
'approv'd it as a thing that might be of ſingular uſe
'to facilitate an Intercourſe between People of diffe-
'rent Languages, and conſequently a proper and ef-
'fectual Means for advancing all the Parts of Real
'and Uſeful Knowledge, civilizing Barbarous Nati-
'ons, propagating the Goſpel, aud increaſing Traffick
'and Commerce; which prevail'd with his Majeſty
'to grant his ſaid Letters of Recommendation to as
'many of his Subjects, eſpecially the Clergy, as were
'truly apprehenſive and ſenſible of the defectiveneſs
'of Art, chiefly in this Particular of Language, what
'a great loſs Mankind is at thereby, how acceptable
'it would be before God, and praiſe-worthy among
'Men, to encourage and advance thoſe Ways of
'Learning, wherein the general Good of Mankind is
'intended; that ſuch Perſons would, as their Affe-
'ctions ſhall incline them, and their Places enable
'them, put their helping Hands to the bringing forth
'this (as yet) Infant Deſign, now ſticking in the
'Birth.

Theſe are the Words of his Majeſty's Letters, wherein he was pleaſed to declare he would give ſome Token of his Royal Favour for the helping forward that ſo laudable and hopeful Enterprize.

There is no Conjecture to be made why the Biſhop ſhould have forborn to name this Gentleman, but what is to be collected from his own Epiſtle, and from Mr. *Dalgarno*'s Book. In the former it appears that the Biſhop had form'd his Tables for the aſſiſtance of another Perſon in ſo worthy an Undertaking; but that Perſon did not think fit to make uſe of thoſe Tables. And by Mr. *Dalgarno*'s Book, it is evident that he was in his Judgment againſt thoſe Tables, as being too tedious and difficult, and ſuch as Philoſophers were not agreed in, and by conſequence other Men of different Languages and Nations, could not have the ſame Idea's about them; by which it is

probable he gave the Bishop some Disgust, which might be the occasion why he did not mention his Name.

The Title of Mr. *Dalgarno*'s Book is, *Ars Signorum, vulgo Character Universalis & Lingua Philosophica. Qua poterunt, homines diversissimorum Idiomatum, Spatio duarum septimanarum, omnia Animi sui sensa (in rebus familiaribus) non minus intelligibiliter, sive scribendo, sive loquendo, mutuo communicare, quam linguis propriis vernaculis. Præterea, hinc etiam poterunt Juvenes Philosophiæ, Principia & veram Logicæ praxin, citius & facilius multo imbibere, quam ex vulgaribus Philosophorum Scriptis.*

This is enough to shew that Mr. *Dalgarno*'s Design, tho' he differ'd in the Method, was the same, in the main, with the Bishop's, to which we now return. He divides his Book into four Parts; the first contains the *Prolegomena*, and is divided into Five Chapters. The First Chapter hath Four Sections: The First contains the Introduction; the Second, the Original of Languages; wherein he delivers his Opinion, That the first Language was concreated with our First Parents. The Rise of the Confusion of Languages is well enough known, but what number of Languages sprung up at that Confusion, is not certain; the most receiv'd Conjecture is, that they were 70, or 72, tho' there be strong Probabilities to prove that there were not so many, and that the first Dispersion did not divide Mankind into so many Colonies. But the Languages now us'd in the World, do far exceed this Number. *Pliny* and *Strabo* make mention of 300 Nations of different Languages, from whence People resorted to *Dioscuria*, a great Mart-Town in *Colchos*; which considering the narrow compass of Traffick, before the Invention of the Magnetick Needle, must needs be but a small proportion, in comparison to the rest of the World. Some *American* Histories say, That in every 80 Miles of that Coun-

Country, the Inhabitants ſpeak a different Language. *Joſeph Scaliger* reckons Eleven Mother Tongues in *Europe*, which have no dependance on one another; but they are ſo well known, that we need not inſiſt upon them. Beſides this difference of Languages in their firſt Derivation, every particular Tongue has its ſeveral Dialects in one and the ſame Nation. The *Hebrew* is by many Learned Men ſuppos'd to be the firſt Mother Tongue of thoſe now known in the World. When the *Jews* were Captives at *Babylon*, their Language was mix'd with the *Caldean*; and after the Captivity, the Pure *Hebrew* ceas'd to be Vulgar, and remain'd only amongſt Learned Men; as we find by *Nehemiah*, 8. 7, 8. And the Pure *Hebrew* now in being is only that of the Old Teſtament; which tho' ſufficient to expreſs what is there intended, is not ſo for Converſation, and therefore is gueſs'd not to be the ſame which was concreated with our Firſt Parents, and ſpoken in Paradiſe.

The Second Chapter conſiſts of Four Sections. The Firſt concerns the various Changes to which all Vulgar Tongues are obnoxious. The Second gives Proofs of ſuch Changes in the *Engliſh* Tongue in the Lord's Prayer, from the Year of *Chriſt* 700, to 1537. The Third Section determines in the Affirmative, that ſeveral of the Ancient Languages are loſt, ſince 'tis evident from the Inſtance of our own, that in ſome few hundreds of Years, a Language may be ſo chang'd, as to be ſcarce intelligible. The Fourth Section accounts for the Riſe and Occaſion of New Languages; which he ſays proceeds from Commerce, and Mixture of People by Conqueſts, Marriage of Princes, or otherwiſe; and inſtances in that call'd the *Malayan* Tongue, the neweſt in the World, and as common among the Natives of the *Eaſt Indies*, as *Latin* and *French* in *Europe*. It was invented or occaſion'd by a Concourſe of Fiſhermen from *Pegu*, *Siam*, *Bengala*, and other Nations at *Malacca*, where they built

the Town of that Name, and agreed upon a distinct Language made up of the easiest Words belonging to each Nation.

The Third Chapter consists of 4 Sections. The First treats of the Original of Letters and Writing. Our Author tells us, it is most generally agreed, That *Adam* in process of time, upon his Experience of the great necessity of Letters, did first invent the ancient *Hebrew* Character; but he rejects those particular Alphabets which are by some ascrib'd to *Adam*, *Enoch*, and *Noah*; and adds, that it has been abundantly cleared by Learned Men, that the ancient *Hebrew* Character has the Priority before any now known. And 'tis none of the least Arguments for the Truth and Divine Authority of the Holy Scriptures, to consider the general Concurrence of all manner of Evidence for the Antiquity of the *Hebrew*, and the Derivation of all other Letters from it. In the Second Section he gives us the Opinion of many of the Ancients, to confirm the Derivation of other Letters and Languages from the *Hebrew*. In the Third, he shews us that the Use of Letters is less ancient, and the Kinds of them less numerous than the Languages themselves. He proves this by several Instances, that many Nations do not yet understand the Use of Letters, and that tho' the *German* and *French* Tongues be ancient, it is not much above 400 Years since Books began to be writ in those Languages: And the reason why Letters are less numerous than Languages, is, That several Nations borrow'd the Use of Letters from their Neighbours, and adapted them to their own Languages. In the Fourth Section, he gives us an Account of the Hieroglyphicks of the Ancients, which was a meer Shift they were put to for want of Letters, and was a slight and imperfect Invention, suitable to those first and ruder Ages. He treats also of the secret and occult ways of Writing, taught by the Abbot *Trithemius*,

mius, for which he was falſly accuſed of Magick. He gives us ſome Hints about Letters or Marks uſed by the Ancients for Brevity ſake; of which Nature is Short-Hand, ſo common in *England*. In the Fifth Section, he gives an Account of ſome ancient Attempts towards a Real Character, to ſignify Things and Notions. And in the Sixth informs us, that no Alphabet now in being, was invented at once, or by Rules of Art; but all of 'em, except the *Hebrew*, were taken up by Imitation.

The Fourth Chapter conſiſts of Six Sections. The Firſt treats of the Defects in the Common Alphabets, as to their true Order, which is inartificial and confus'd, the Vowels and Conſonants being huddled together without any Diſtinction; whereas the Vowels and Conſonants ſhould be reduc'd into Claſſes, according to their ſeveral kinds. In the Second Section, he takes notice of the Redundancy and Deficiency of the *Hebrew* Alphabet, and likewiſe of the *Greek* and *Latin*. In the Third Section, he ſhews that they are very uncertain as to their Powers and Signification; of which he gives ſeveral Inſtances in our own Language. In the Fourth Section, he takes notice that the Names of the Letters in moſt Alphabets are very improperly expreſſed by Words of ſeveral Syllables. In this reſpect, the *Roman* and *Engliſh* Alphabet are more convenient than the reſt, though not without ſome Defects of the ſame Nature. In the Fifth Section, he ſays their Figures do not correſpond ſufficiently with their Natures and Powers, and obſerves that the manner of Writing the Oriental Tongues from Right to Left, is as unnatural as to write with Light on the wrong ſide. In the Sixth Section, he takes notice of the Defects of Words as well as Letters; ſome of them being Equivocal, others Synonimous, beſides the Irregularities in Grammar, and the difference betwixt writing and pronouncing Words. On this Occaſion, he takes notice

tice of the Endeavours of Sir *Thomas Smith*, and others, to rectify our *English* Orthography, tho' we still obstinately retain the Errors of our Ancestors.

The Fifth Chapter has Three Sections. The First maintains, That neither Letters nor Languages have been regularly Established by Rules of Art: Nor cou'd it be otherwise, because Grammar (by which they should be regulated) is of a much later Invention than the Languages themselves; as is evident from the *Hebrew*; which, tho' the oldest of all, was not reduc'd into Order of Grammar till the Year 1040. In the Second, he treats of the Natural Ground and Principle of the several Ways of Communication among Men; where he tells us, That as they generally agree in the same Principle of Reason, they likewise agree in the same Internal Notion or Apprehension of Things; and those Internal Notions they communicate to the Ear by Sounds, and particularly by Words, and to the Eye they communicate them by Motion and Figure, *&c.* and more particularly by Writing: So that if Men should generally agree upon the same way of Expression as they agree in the same Notion, we should then be free from that Curse of the Confusion of Tongues, and all the unhappy Consequences of it. This is only to be done by some one Language and Character to be universally practised, and enjoined by Authority; which cannot be expected without an *Universal Monarchy*; and perhaps not then: Or else by some Method which (without such Authority) might engage Men to learn it, because of its Facility and Usefulness, which was the Design of this *Essay*. The Third Section informs us, That in order to this, the first thing to be consider'd, was a just Enumeration and Description of such things as were to have Marks or Names assigned them, and to be so contrived, as to be full and adequate without Redundancy or Defect as to their Number, and regular as to their Place and Order.

der. And, if every Thing and Notion had a diſtinct Mark, with ſome Proviſion to expreſs Grammatical Derivations and Inflections, it would anſwer one great End of a Real Character, to ſignify Things and not Words. And if ſeveral diſtinct Words were aſſigned for the Names of ſuch Things, with fixed Rules for ſuch Grammatical Derivations and Inflections as are natural and neceſſary, it would make a more eaſie and convenient Language than any yet in being.

Then if theſe Marks or Notes could be ſo contriv'd, as to have ſuch a dependance upon, and relation to one another, as might ſuit the Nature of the Things and Notions they repreſent; and likewiſe, if the Names of Things could be ſo ordered, as to contain ſuch an Affinity or Oppoſition in their Letters and Sounds, as might ſome way anſwer the Nature of the Things they ſignify, it would be a further Advantage, by which, beſides helping the Memory by Natural Method, the Underſtanding would be improv'd; and by learning the Characters and Names of Things, we ſhould likewiſe learn their Natures.

Thus our Author concludes the Firſt Part, and comes to the Second; which contains a regular Enumeration and Deſcription of all thoſe Things and Notions to which Names are to be aſſigned, and forms a Syſtem of Univerſal Philoſophy. This Part is divided into Twelve Chapters The Firſt contains Six Sections. The Firſt Section has a Scheme of Genus's, or more common Heads of Things belonging to this Deſign. Then he ſhews how each of them may be ſubdivided by its peculiar Differences, which for the better Convenience of the Deſign, he determines for moſt part to the Number of Six, except in the Numerous Tribes of Herbs, Trees, Exanguious Animals, Fiſhes and Birds, which cannot be comprehended in ſo narrow a Compaſs. Then

he

he enumerates the ſeveral Species belonging to each of thoſe Differences, in ſuch an Order and Dependance, as may contribute to define them, and determine their primary Significations. Theſe Species he commonly joins together in Pairs, for helping the Memory; and ſo likewiſe are ſome of the Genus's and Differences; thoſe things which naturally have Oppoſites, are join'd with them, according to ſuch Oppoſition, whether ſingle or double; and thoſe things that have no Oppoſites, are commonly join'd together with reſpect to ſome Affinity which they have to one another, tho' ſometimes thoſe Affinities are leſs proper and more remote; there being ſeveral things ſhifted into thoſe Places, becauſe the Author did not know how to provide for them better. The Second Section relates to the more general Notions of Things, and the difficulty of Eſtabliſhing thoſe Notions aright. The Third treats of Tranſcendentals General. The Fourth of Tranſcendental Relations mix'd. The Fifth of Tranſcendental Relations of Action; and the Sixth of the ſeveral Notions belonging to Grammar or Logick. But theſe Things being digeſted into Tables, we muſt refer the Reader to the Book it ſelf, for a diſtinct Idea of them.

The Second Chapter conſiſts of Two Sections. The Firſt is concerning God; and the Second concerning the ſeveral Things and Notions reducible under that Collective *Genus* of the World: Which is alſo digeſted into Tables.

The Third Chapter conſiſts of Three Sections. The Firſt is of Elements and Meteors; the Second of Stones; and the Third of Metals: Digeſted alſo into Tables.

The Fourth Chapter has Seven Sections. The Firſt of Plants; the Second concerning a more general Diſtribution of 'em; the Third, Fourth, and Fifth, treat of Herbs; conſider'd according to their Leaves, Flowers, and Seed-Veſſels. The Sixth treats

of

of Shrubs; and the Seventh of Trees. All of 'em likewise in Tables.

The Fifth Chapter has Six Sections. The First concerns Animals, and the general Distribution of 'em; the Second is of Exanguious Animals; the Third of Fish; the Fourth of Birds; the Fifth of Beasts; and the Sixth has a Digression concerning *Noah*'s Ark: Wherein he maintains the Truth and Authority of the Scripture, against the Objections of Atheists and Hereticks, That a Vessel of such Dimensions could not contain so vast a Multitude of Animals, with a whole Year's Provision for 'em.

The Sixth Chapter relates to the Parts of Animate Bodies; First, peculiar; Secondly, general: And these are also digested into Tables.

The Seventh Chapter relates to the Predicament of Quantity. 1. Of Magnitude. 2. Of Space. 3. Of Measure. All digested into Tables.

The Eighth Chapter relates to Quality, and its several *Genus's*. 1. Of Natural Power. 2. Of Habit. 3. Of Manners. 4. Of sensible Quality. 5. Of Diseases. With the various Differences and Species under each.

The Ninth Chapter treats of Action, and its several *Genus's*. 1. Spiritual. 2. Corporeal. 3. Motion. 4. Operation.

The Tenth Chapter concerns more private Relation. 1. Of Family Relation; with the several kinds of Things belonging to those in that Capacity, either as Possessions, or Provisions.

The Eleventh Chapter concerns Publick Relations; as Civil, Judiciary, Naval, Military, and Ecclesiastical.

The Twelfth Chapter explains the Design of the foregoing Tables; gives particular Instances of the 6 principal *Genus's* of it; has some Notes concerning Opposites and *Synonyma's*; and an Account of such Things as ought not to be provided for in those Tables.

The

The Third Part contains a Philosophical Grammar; and is divided into Fourteen Chapters.

The First Chapter concerns the several Kinds and Parts of Grammar. 2. Of Etymology; and the more General Scheme of Integrals and Particles. 3. Of Nouns in general. 4. Of Substantives common, denoting either Things, Actions, or Persons. 5. Rules concerning Nouns of Action. 6. Of Substantives Abstracts. 7. Of Adjectives, according to the true Philosophical Notion of them. 8. The true Notion of a Verb. 9. Of derived Adverbs. 10. A General Scheme of the forementioned Derivations.

The Second Chapter concerns Particles in general. 2. Of the *Copula*. 3. Of Pronouns more generally. 4. More particularly. 5. Of Interjections more generally. 6. More particularly.

The Third Chapter treats of Prepositions in general. 2. The particular Kinds of them enumerated. 3. An Explication of the Four last Combinations of them, relating to Place or Time.

The Fourth Chapter concerns Adverbs in general. 2. The particular Kinds of them. 3. Conjunctions.

The Fifth Chapter treats of Articles. 2. Of Moods. 3. Of Tenses. 4. The most distinct way of expressing the Differences of Time.

The Sixth Chapter concerns Transcendental Particles, and the End and Use of them. 2. The usual ways for enlarging the Sense of Words in instituted Languages. 3. The General Heads of Transcendental Particles.

The Seventh Chapter has Instances of the great Usefulness of those Transcendental Particles; with Directions how they are to be applied.

The Eighth Chapter treats of the Accidental Differences of Words. 1. Inflexion. 2. Derivation. 3. Composition.

The Ninth Chapter is of the Second Part of Grammar, called *Syntax*. The

The Tenth Chapter is of Orthography ; and contains Three Sections. The First concerning Letters; and the Authors who have treated of this Subject: Of whom Dr. *Wallis* seems with the greatest Accurateness and Subtilty to have consider'd the Philosophy of Articulate Sounds. The Second contains a brief Table of all such Kinds of simple Sounds, as can be framed with the Mouths of Men. The Third contains a further Explanation of this Table, as to the Organs of Speech, and as to the Letters framed by those Organs.

The Eleventh treats of Vowels. The Twelfth of Consonants. The Thirteenth of Compound Vowels and Consonants. The Fourteenth treats of the Accidents of Letters: 1. Their Names. 2. Their Order. 3. Affinities and Oppositions. 4. Their Figures; with a Twofold Instance of a more regular Character for the Letters: The latter of which may be esteemed Natural. 5. Of Pronunciation. 6. The several Letters disus'd by several Nations.

The Fourth Part contains a Real Character and Philosophical Language. This consists of Six Chapters: The 1st. treats of a Proposal of one kind of RealCharacter amongst many others which might be offer'd both for the Integrals, whether *Genus*'s, Differences, or Species, together with the Derivations and Inflexions belonging to them; as likewise for all the several kinds of Particles. Here our Author acquaints us, That it were exceeding desirable that the Names of Things might consist of such Sounds as should bear in them some Analogy to their Natures, and the Figure or Character of these Names should bear some proper resemblance to those Sounds; but he does not understand how this Character can be adjusted any otherwise than by Institution: And in the framing of those Characters, he says, special Regard must be had to these Four Properties. 1. That the Figure be plain and easy, so as it may be made

by

by one or at most by Two strokes of the Pen. 2. That they be sufficiently distinguished from one another. 3. Graceful to the Eye. 4. Methodical. But we must refer to the Book it self for our Author's Specimen.

The Second Chapter contains an instance of this Real Character in the Lord's Prayer and Creed.

The Third shews how this Character may be made Affable in a distinct Language, and what kind of Letters or Syllables may be conveniently assign'd to each Character.

The Fourth has a Comparison of the Lord's Prayer and Creed in this Language, with 50 other Languages as to the Facility and Euphony of it. The Fifth contains Directions for the more easy learning this Character and Language; with a brief Table containing the Radicals both Integrals and Particles, together with the Character and Language by which each of 'em are to be express'd.

The Sixth is a Comparison betwixt this Natural Philosophical Grammar, and that of other Instituted Languages, particularly the *Latin*, in respect of the Multitude of unnecessary Rules, and of Anomalisms. It treats also concerning the *China* Character; the several Attempts and Proposals made by others towards a new kind of Character and Language, and the Advantage in respect of Facility which this Philosophical Language has above the *Latin*. In the last place comes an Alphabetical Dictionary wherein all *English* Words according to their various Significations, are either referr'd to their Places in the Philosophical Tables, or explained by such Words as are in those Tables.

F I N I S.

Bayerische Staatsbibliothek München

. HEINRICH
Buchbinderei
Rottenburg/L.

BSB Bayerische StaatsBibliothek
MDZ Münchener DigitalisierungsZentrum Digitale Bibliothek

Wilkins, John,

The Mathematical and Philosophical Works Of the Right Reverend John Wilkins, Late Lord Bishop of Chester Containing, I. The Discovery of a New World ... II. That 'tis probable our Earth is One of the Planets. III. Mercury: Or, The Secret and Swift Messenger ... IV. Mathematical Magick: Or the Wonders that may be perform'd by Mechanical Geometry. V. An

London 1708

Astr.p. 183 n
urn:nbn:de:bvb:12-bsb10138478-9